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How to Obtain Copies of the Photograph Taken at the Boston Meeting.

OFFICE OF THE CHARLESTOWN GAS CO.,
THOMPSON SQUARE, CHARLESTOWN DIST.,
BOSTON, Nov. 9th, 1881.

Members of the American Gas Light Association, and others, wishing for copies of the picture of the "Group of Gas Men," taken at the works of the Boston Gas Light Company, Oct 20th, 1881, are requested to forward their orders for the same to the undersigned, with $1.50 for each copy desired.

GEO. B. NEAL,

Charlestown, Mass.

THE CONTROL OF GAS TO THE POINT OF CONSUMPTION

It is probable that never in the history of the gas industry in this country have the companies done as large a business as during the past year, and were never in a more prosperous condition than now. Moreover, everything indicates that the business of next year will be even larger, and that many companies will have seriously to consider the immediate enlargement of their generating, storing and distributing plant.

It is undoubtedly true, owing to the many reductions in the charge for gas, made from time to time since the year 1873, that the net earnings in many cases are not so great as they were eight years ago; but, the net earnings now obtained being from a larger consumption, the companies now stand on a surer foundation than before.

It is well to stop and consider, in times of prosperity, whether the present condition is one of entire security, and whether the future promises not only to extend but also to improve the present state of affairs. It would seem that if; notwithstanding the general and great unpopularity of gas companies and, in some cases, an excessive charge for a poor article, in others a degree of carelessness and waste that would be ruinous to any other industry, and a general, but not universal, disregard of what is done with the gas after it has passed the meter, together with an enormous supply, at extremely low prices, at our very doors of a formidable competitor in the shape of oil; the industry is in an eminently prosperous condition, there must be something of great merit inherent in the gas itself. And thus we believe, and accept as true, the words of a distinguished electrician, who has had occasion to carefully look over the whole field of lighting, that "Gas is a pretty good thing in itself." This being so, instead of presuming upon it, should not every effort be made to sustain and stimulate the industry in all its varied branches?

It is idle to shut our eyes against the immense struggle being made by others to obtain a portion of our business. Never within the same space of time has so much money, and thought of the highest order, been devoted to the advancement of an industry as has, during the past three years, been given to developing against us a competitor in lighting by electricity—while we know that little has been the outcome of all these great efforts, and think it probable that, if the gas industry had had the same amount of money and brains expended upon its development, in its many most promising fields for investigation and improvement, it would now be so far ahead as to have hopelessly distanced all possible competitors, still we believe this to be the time for watchfulness and aggression.

Considering, simply for the sake of argument, that electricity is a rival in some parts of the field now occupied by us, we believe in the application of the old adage, "Fas est ab hoste doceri," as wherever the electric light has been introduced it has been surrounded by every appliance that money and ingenuity could suggest to utilize to the full its illuminating value, and in nearly every case it has been pitted against either an inadequate, wasteful, or illy-devised gas supply, for which the companies, using every exertion to make and distribute a good gas, were not responsible. Much labor and thought have been given to the production and distribution of gas to the outlet of the consumer's meter, and there a good and economical article is made costly or annoying because an ignorant gas fitter was only interested in obtaining a big price for putting down and covering up an insufficient system of supply pipes, at the end of which he has put on low-priced and wasteful burners, and surrounded them with shades which absorb a large

portion of the light furnished by the bad burners, and throw a very considerable quantity of the remaining light on the ceiling where it is not wanted. This may be considered an extreme view of the case, but all know that these things exist to a very considerable and damaging extent.

What is the remedy? We have yet to see a convincing or even strong argument against the companies either doing the entire fitting from the meter to, and including, the burner, or else adopting such a stringent system of inspection as will ensure their consumers being given an ample supply at all points in their buildings, and fitted with such burners, shades and other appliances as will enable them to obtain good results from the gas consumed. Self-preservation is the first law of Nature—gas is made for the profits derived from its consumption; if its use is, by any cause, made wasteful and costly to the consumer then this must react and curtail the profits of the producer; it would seem, therefore, almost a business axiom that the interests of the producer and consumer should be protected, whatever outside interest may suffer. The stream cannot rise above its source, the gas fitter should not obstruct the prosperity of the producer, by which he subsists.

West of Scotland Association of Gas Managers.

At the Nineteenth Half Yearly Meeting of this Association, held in Glasgow, Scotland, Oct. 6th, President Samuel Dalziel delivered the usual inaugural address. We regret our inability to reproduce his remarks in full, but make the following extracts:

"As yet we have the field to ourselves. Every part of the apparatus, from the retort to the gas burner, has been vastly improved, so that we can tell what every pound of coal should produce in gas, and how many candles light it will yield. There is no waste now, such as occurred in the early days of gas lighting, when the yield of gas was little more than half what it is now, when gas managers buried their tar out of sight as an unclean thing and gas liquor was run to waste. These days are long past, and now every product of distillation has its value.

"I believe gas light will ever hold its own. Hitherto its chief use has been the illumination of our workshops and dwellings; and light for light, cost for cost, for steadiness and reliability, it will be with difficulty, if ever it can be surpassed. No other light has ever been so submissive to our commands. It is ready to blaze forth at the command of a child, or submit to be kept down to the tiniest spark. There are many other uses to which it is being applied, and I believe the time is rapidly approaching when every house will have its cooking stove, and when gas will be the motive power employed to brush our boots, clean our knives, etc. In one large establishment in Edinburgh the motive power for the printing press is the gas engine. In Kilmarnock there is the same, besides other uses to which gas is applied; and it is not unlikely that gas may be the motive power to make electricity outshine himself. If we are to prevail and hold our own, we must apply ourselves with greater diligence to master the details of our profession, such as the selection of coals, the erection of retort-benches, the generation and purification of gas, and its distribution, from the holder up to the burner.

"This latter department—especially the burners—is occupying the attention of many scientific men, with very favorable results. Mr. Sugg, Mr. Bray, and others, have done and are still doing much to show that, as an illuminant, gas is capable, with their improved burners, of yielding much more light than has hitherto been obtained from the quantity of gas consumed, and that when employed with proper burners it will not be easily driven from the field.

"There is also the hitherto neglected department of residual products—the tar and liquor—the manufacture of which will eventually, I believe, become a department in every gas works."

The Petroleum Outlook.

The late appreciation of prices and the apparent fact that the market will be likely to rule at somewhat higher figures than it did during the summer, give warrant of the correctness of the review of the situation as set forth in our August supplement. In the progress of rapid development of the Richburg field, during the past two months, the present condition of that field is substantially what we predicted it would be; and its character is now becoming generally regarded as fixed—as an outlying deposit, in no way connected with or analogous to the Bradford field. Its oil comes from the second sand: the gravity of the oil is lower than the Bradford oil, and the rock which contains it is broken and irregular.

The production of the Bradford field, however, has lately shown a greater tenacity—less likelihood to decline—than has been generally supposed. During last fall and winter, and the early months of this year, the actual production was not obtainable, nor could anything like accurate estimates be made. This was in consequence of the large stocks in wooden tankage at the wells, and in consequence, also, of the suppression of production, on account of the inability of the pipe lines to take care of the excess; now, however, that the surplus stocks at the wells, in Bradford, have been taken into the lines, the average daily runs indicate with reasonable certainty the daily production. In revising the past estimates by means of this changed condition, it has become plain that our production during last fall and winter, and in the early part of this year, was greatly underestimated. It is now obvious that from the point of highest production last fall to the present time, the decline has been very considerable. It would be unwise, nevertheless, for us to expect a continuance of this rate of rapid decline, because the average of the wells have got down to a point where we must look for a much more gradual falling-off, and because all the experience of the business teaches us that when wells fall to six barrels per day, they fall off slowly until the approach of final exhaustion, and the average of the Bradford wells is less than six barrels.

The figures which we present this month, as compared with those of the preceding month, show a decline of 2,103 barrels per day. Owing to the fact that during the month of September a number of wells were compelled to stop on account of the scarcity of water, a larger decline was generally expected.

From the present condition of things in the field and in the trade we are not inclined to look for any substantial or permanent advance in prices before the opening of next year's business.

The export trade is now pretty well supplied; we are carrying large stocks which, without much doubt, will continue to increase until the active opening of next year's business. The production is still largely in excess of the world's current needs; the home trade, which came in earlier this year than it usually does, is rapidly being supplied, and when this is accomplished we will be substantially at the end of this year's business. Added to this, the late advance in prices has greatly stimulated the activity of the drill both at Bradford and Richburg.

Of course we may, and doubtless will, have speculative disturbances, but we cannot hope to have that permanently higher range in the market which comes from actually diminished production, or from a strong prospect of a diminishing production, until the opening of next year's business. In the meantime the most natural thing to look for is a lull, which will furnish but little consolation or profit to either the "bull" or the "bear."—*Stowell's Petroleum Reporter.*

Work Accomplished on the Panama Canal.

The president of the American Branch of the (De Lesseps) Panama Canal Company, according to the *Scientific American*, has issued a statement of the condition of the work. Notwithstanding the obstacles encountered in the luxuriant vegetation and the thick forests, there has been opened and recorded transversely to the axis of the canal over 200 kilometers of paths, and also a passage from 20 to 30 meters has been made from one end of the Isthmus to the other, according to the proposed lines of the Canal Commission. For meteorological studies, to which especial attention has been given, four stations have been established—at Colon, Gamboa, La Boca del Rio Grande, and Naos Island. Geological surveys have been made and are now in progress. It has been ascertained that between Colon and Lion Hill the canal will not encounter any rocks. At the present time two steam sounding apparatus are being put up similar to those at Colon. At this station the samples brought up by the spoons have given an exact structure of the soil. It is shown to be a succession of layers of clay, representing the degradations of a greenish pyroxenic rock, which through its gradual degradations and decomposition has produced this formation. At other places the ground, bored to a depth of 25 meters, has revealed nearly every way, instead of successive formations methodically arranged, a chain of derived rocks growing softer and softer. The thickness of the mellow soil is quite remarkable, and, in a word, the soundings have given results beyond expectation on the whole line of the canal.

Work on the canal has been commenced. The company now have 200 cars, 12 locomotives, 2 pontoons, 2 steam cranes, 18 flat boats, 2 dredges with change pieces, ribbon saws, rails, etc., a part of which is at Colon and the remainder is on the way. The storehouses at Colon cover an area of 1,400 meters, and are full. Five barges and two steamboats are plying upon the Chagres River. Another steamboat at Panama is used for hydrographic surveys of the bay.

MM. BECQUEREL, at a recent meeting of the Paris Academy of Science demonstrated that the propagation of frost was shown to be slower in grassy ground than in bare ground.

In the latter the rate increases very slightly with the depth, the propagation being very regular. In grassy ground the increase is very noticeable, and with increasing depth the rate tends to come near that in the bare ground.

[Official Report.—Continued from page 200.]

Ninth Annual Meeting of the American Gas Light Association.

Held at the Hotel Brunswick, Boston, Mass.,

Oct. 19, 20, and 21, 1881.

Afternoon Session—Oct. 19.

Discussion on Mr. Humphreys' Paper.

Mr. Harbison—If I correctly understood the reading of the paper, Mr. Humphreys makes the point that any works that is running six benches as the maximum can economically and advantageously use the Ross stoker. I would like to ask if it would be necessary to have two stokers and a double set of machinery for running a double stack of benches, if there were six in a stack, placing three on either side of the room—whether it would not be necessary in that case to have two stokers, involving a double investment, and consequently an increase of cost beyond the figures given in the paper to which we have listened. If any gentleman has had practical experience with regard to that point, I would like to hear from him.

The President—Doubtless some of the gentlemen who are familiar with the use of the Ross stoker can answer that question.

Mr. Helme—Mr. Harbison will notice that very few works of six benches have a Ross stoker. They are not generally used except where there are 10 or 12 benches. If you are going to introduce the Ross stoker, then, beyond all question, you would have to have all your benches face one way. It would not pay, with even eight or ten benches, to have the Ross stoker introduced on each side, and have the benches back to back. Wherever you are preparing to use the Ross stoker in works so small as six benches, you must build the works so that the benches shall all face the same way.

Mr. Harbison—If you have a stack of 20 benches, the benches on either side of the house, your minimum production in summer runs down to what six benches will produce. Is it more economical to run six benches on one side of the house, and not have the heat which would come from the other side, and use the Ross stoker; or to run them in the ordinary way, three benches on either side of the house, and use the present mode of drawing and charging?

Mr. Greenough—Apropos of this question, although not in answer to what Mr. Harbison has asked, I think it may be of interest to bring to the attention of the Association a fact which struck me this summer in my short trip through Germany; that is, that many of the new gas works which are being built on the Continent are made with a single stack. In place of the double stack, such as we are accustomed to see, the stack is cut in two and pushed back on either side of the house, leaving a wide open space in the middle. Although the custom struck me at first as rather curious, yet after some little time I came to the conclusion that there were many advantages to be derived from that system of setting, and among the advantages would certainly be that of having it necessary to use but one track and one open space in the middle through which the drawing and charging machine would work. If it were worked in that way it would meet the objection of Mr. Harbison.

Mr. Harbison—I would like to ask Mr. Greenough whether he thinks it would be economical to work in that way, and, if we are going to build a stack of benches in a retort house, to split them in two and build half of them on either side of the room, with an open space in the middle; or to build a double stack, and, in consequence of having one stack on either side of the house, to use the Ross stoker—supposing that the Ross stoker can be used on either side.

Mr. Floyd—The Manhattan Gas Light Company of New York city are now altering their works. They are building a tramway at the end of the works, so that they can run the machine down on one side and then turn and run it up on the other. The same machine will thus answer for both sides of the stack.

Mr. Greenough—I am not prepared to state definitely my opinion in reply to the inquiry of Mr. Harbison. I was certainly very much pleased with the appearance of the house, in which the entire center was open and high and light—very much more so than it is in our present system of building. The houses were built with cellars, with a stack on either side, each stack being heated by underground furnaces, and the flues were brought along the rear of the stack above the ground, where they could be easily got at, and brought, in the center of each stack, into a high chimney on the outside of the building. The whole arrangement was very complete, and every part of it could be easily got at and repaired in case of any trouble. But, without making more figures than I have on the subject, I am not prepared to say that I would recommend that system; but if I were to rebuild, I would certainly give that system very mature consideration, for I think there are many advantages connected with it.

Mr. Helme—I would ask whether the men did not suffer very considerably in filling the benches.

Mr. Greenough—The space between the two benches was very much greater than the ordinary space between the bench and the wall. I do not think I saw any retort houses where the space between the benches was less than 40 feet.

Mr. Helme—Then it would take more roof surface to cover the benches.

Mr. Greenough—Very little if any more.

Mr. Helme—The only difference that I see between the Indianapolis retort house and the one you describe is that their benches run across the retort house and then back. They have four, with six stacks. It looks very nice, and they do not lose the advantage of having the benches back up; they do not lose the heat.

Mr. Greenough—But, on the other hand, they would lose the advantage of charging by a stoker in any long system of benches.

Mr. Helme—There would not be a great deal of area that could be used in a distance of 40 feet.

Mr. Armington—It seems to me that the question can be answered very readily. If fuel were cheap, so that you could have four times the radiating surface in one plan that you can have in the other, it would be an admirable plan to set the benches on either side of the house; but if the cost of the fuel is to be regarded, I think our present system is very much better.

Mr. Greenough—I do not think he will lose four times; he will only lose twice. The same number of retorts would be divided up, and they would offer one surface more for radiating than previously. It would require a little more brickwork; but in respect to the quantity of fuel, I know that the stacks heated in that way required much less fuel than a double stack of retorts set in the ordinary way.

Mr. Armington—I suppose that is due to the fact that they make the fue into gas. It seems to me that it must at once strike any person that the would be double heat in each case, because you have the exposed oric work, and you have the side of the house, where you are subject currents. At the center of the house you have no current except that produced by radiation from the benches. You have to use the same amount of machinery for shifting your stoker across the house that you would have in shifting across the bench. I do not see much difference in that respect; and so far as the radiation is concerned, if the fuel were burned in the old way, instead of being made into gas and burned, I have no doubt there would be a very material increase.

Mr. Greenough—I want the gentlemen to notice that I have not recommended that plan.

Mr. Sherman—I had the pleasure of looking over this very interesting paper. I notice that Mr. Humphreys estimates $13,500 as the cost of the Ross stoker and charger, which is the price of one machine. Mr. Ross advocates the employment of a turn-table in works where it is possible, and, thus arranged, one machine will answer for both sides.

Mr. Stedman—In estimating the loss of heat by radiation from the two sides of the retort being exposed, I think we are in error in supposing that the loss of heat from the rear would be as great as it is from the front. The rear wall is very much thicker than the front wall, as it always includes escape flues for the waste heat of the bench. In our works in Newport we have only single benches, all facing one way, and we do not find that the loss of heat is excessive in comparison with benches which are set back to back. We do not find that our use of fuel exceeds their's. We do not find that in running two benches we get quite as great a result from the yield of the two benches per diem as they do in considerably larger works, where the stacks are placed back to back. I think that, in estimating the economy of working single benches, it would be quite wrong to assume that the loss by radiation would be even twice what it would be from benches placed back to back.

Mr. Armington—If I understood the paper, the author does not find any loss. He runs his benches as economically as those that are placed back to back. It reminds me of a circumstance that transpired a year ago. I wanted to buy a Springfield gas machine for a country house. I waited upon the agent who sold them, and he asked, "Do you want the carburetter, to be put into the ground, made of copper or of iron?" I said, "Of copper, of course; why did you ask that?" He replied, "There are some who come here to trade with me for whom the Almighty alters his laws. I have plenty of people come here and say that they had just as lief have iron as copper, because one will last just as long in the ground as the other. That is a class of people that the Almighty alters his laws for." I think it is just so with radiating surfaces. If he can save more fuel with single benches than he can when they are placed back to back, then I think the Almighty has made a change in his laws for his benefit.

Mr. Stedman—We do not pretend to be operating under a special providence; but we do claim that the amount of surface exposed at the back is the same as at the front, and that the walls are very much thicker. The radiation of heat through brickwork, or through any other material, is in proportion to the thickness of the material, whether it be of iron, brick, or

any other substance. You will also notice that if the waste heat of the bench passes up through flues that cover a considerable portion of the back end of the bench, that resists the tendency to radiation of the heat from the bench. So that in estimating the waste of heat you have to allow for the resistance opposed by the flues that are carrying off the waste heat of the bench. The heat radiated from the flues is all lost upon the bench itself. I think these things ought to be taken into consideration. What we claim is, not that we disregard the laws of nature, or call for special dispensations, or anything of that sort; but simply that, in estimating the loss of heat at even twice as great as it would be from benches placed back to back, we are liable to fall into an error.

Mr. Greenough—I will ask the gentleman from Brooklyn what excess of fuel he supposes that radiation amounts to. Supposing that the radiation were twice as much from a single as from a double, how much does he think that would amount to?

Mr. Armington—Just twice as much as he radiated.

Mr. Greenough—Five per cent.?

Mr. Armington—I do not think that five per cent. would cover it. I think it would exceed that. I doubt if ten per cent. would cover it.

Mr. Stedman—Merely as a matter of guess, I should say that three per cent. would cover it.

Mr. Gerould—I am not so near Providence as our friend Mr. Stedman, and may not speak with equal authority. My benches are built back to back. I cannot see any difference, in the use of fuel, whether using one bench in the stack or two benches back to back. I do not think that the difference of radiation would amount to one per cent.

Mr. How—Will some of the gentlemen who have had experience with both systems tell us how much coke per thousand they actually use?

The President—That would be good testimony on the subject.

Mr. How—Is it not the best answer to the question?

The President—Is anyone prepared to give the information suggested by Mr. How?

Mr. Harbison—There may not be any gentleman present who can give that information; but there may be some who are familiar with the various gas works in which the two plans are in operation, and who may have knowledge on the subject. Without mentioning places, they might be able to give an answer to Mr. How's question, and thereby furnish information to all of us.

Mr. Rowland—With all due deference to the opinion of my friend, I think he lays too much stress upon the loss by radiation. I have my doubts whether the loss by radiation is measurable, if the bench is properly set. We often set boilers, with a space between them, in a thick wall, and you can put your hand on the wall. In the case that Mr. Greenough speaks of, I think the radiation would not amount to anything if they would build two walls, and fill in the space between the walls with some non-conducting material. That is my experience. I have not myself run any gas works, but I have been around where they were running them, and I have had opportunities of comparing the single with the double settings.

Mr. Weber—Among the German gas men it is the custom, when benches are built in sections, to make a difference in the outside benches of five per cent. loss by radiation. That five per cent. is always allowed for the radiation of the outside benches—I mean on the end benches. Consequently, when you build a single bench you will have a loss of heat by radiation.

Mr. Stedman—That would tally with the statement made a moment ago, that the loss would be about three per cent. in benches placed singly as compared with those placed back to back. The end benches have, of course, a larger surface for radiation than the middle bench in a single stack would have. I think that three or three and a half per cent. would be enough to allow for any end bench when there are two flues for the waste heat, which resist the tendency to radiation. In reply to the inquiry as to the amount of fuel used, I would say that at the present time we are using 120 bushels of coke per day in two fires; and we are producing from 114,000 to 117,000 feet per day, from coke fires alone, from these two benches. The retorts are $14 \times 26 \times 9$. That is a very little over one bushel per thousand feet—120 bushels of coke to 115,000 feet of gas. Those two benches are not end benches, but they have cold benches on each side of them. They are not placed back to back; they have radiation from back and front alike.

Mr. Sherman—I would like to ask Mr. Greenough if he can give any working results of benches set in that way, from information which he gained while abroad.

Mr. Greenough—I cannot give any results as compared with similar benches set back to back. I do not know of any statement of comparative results as between the two systems. My impression is that 2½ or 3 per cent. would be an ample allowance for radiation.

The President—Assuming that the bench was built with reference to saving the heat?

Mr. Greenough—Yes.

Mr. Helme—Is Mr. Stedman's bench the ordinary setting, with no regenerator about it? It strikes me that 10,000 feet per retort is extraordinarily good work.

Mr. Stedman—We have what is known as the Pittsburgh setting, the plan of which we got from Gardner Brothers, of Pittsburgh. I had previously seen it used in Washington and in Cincinnati. The difference between this and the ordinary open setting consists in its having a larger amount of brickwork in a brick wall at the back end of the furnace, which extends to the top of the retorts.

Mr. How—Do we understand you to say that you get 115,000 feet from 12 retorts?

Mr. Stedman—Yes; that is exactly the result we get.

Mr. Harbison—I wish to ask Mr. Stedman whether he attributes this large result principally to the particular style of setting he is using.

Mr. Stedman—I can say in reply that we do attribute it, in our works, to that particular style of setting, never having been able to get such results from the open setting. The advantage in the setting is that the draught never appears to be obstructed at all. The retorts are arranged in such a way that they stand the severe heat necessary to carbonize that amount of coal without giving away in any particular place. An intense fire is generated in the front end, passes up around the retorts at the front, then goes over the bridge wall, and goes downward from the back end of the retort over the flue at the center; it then passes out of that flue at the center, underneath the bottom of the bottom retort; and the bottom of this retort covers the carry-away flue without any intervening walls. It passes underneath the bottom of the bottom retort, then to the front of the lower flue, passing around the division wall which runs longitudinally to this flue, and then back again and out at the ordinary escape gate. This result is reached without any hot coke at all.

The President—Will you state the size of your charges?

Mr. Stedman—The charges are about 300 pounds. I think they vary from that, according to the different locations of the retorts and the different heats which they have.

Mr. Harbison—Are you at all troubled with pitch in the main?

Mr. Stedman—Occasionally we clean out the main. Once in two weeks we open the main and remove the pitch, or hard tarry matter, which accumulates at the bottom of the retorts.

Mr. Cabot—I would like to ask Mr. Stedman if he uses any oil or naphtha with the coal, or whether it is coal alone.

Mr. Stedman—Coal alone. We had not used any oil until day before yesterday. Through the summer we got along without any oil at all; since cooler weather came on we have been using a little cannel. We had some oil left over from last winter, and we have now commenced using it in order to get rid of it. The candle power has averaged a little above 17 candles since the first of the month, when we began to use a mixture of the two coals. Before that we averaged 18 candles, without any enricher at all. In connection with this I want to say something in favor of a hot scrubber. We are using a hot scrubber, and to that we attribute the fact that we were able to keep up the standard through the hot weather without using any enricher whatever.

Mr. Helme—Have you a pretty uniform heat on the benches?

Mr. Stedman—Very uniform indeed; I think the nearest uniformity in heat of any setting that we have ever had; and the lower retort is as near the average heat as in any setting that we have ever used.

Mr. Helme—I am glad to hear that, for I have had some benches built in that way, but have not yet fired them up.

Mr. Nettleton—I would like to ask, in connection with the hot scrubber, if the temperature of the gas as it enters the scrubber is the same as at the outlet.

Mr. Stedman—We keep a record of the temperature of the gas at the outlet as it comes from the hydraulic main. It generally runs from 140° to 160° in the summer time, and a little below that in the winter. The temperature at the inlet varies, of course, according to the nearness or remoteness of the retorts that are in connection with the scrubber. We do not take the temperature of the gas immediately on its exit from the scrubber, because the scrubber, being 25 feet high, the exit pipe is near the top of the retort house. It then passes down and through the ground for perhaps 40 feet, and then enters the condensers. The gas enters the condensers at a temperature of 120°. We apprehend that the temperature is raised considerably in the hot scrubber. In the bottom of the hot scrubber we keep a coil of pipe filled with steam, and on to this coil of pipe we run the whole contents of the hydraulic main; so that we do distil the tar from the hydraulic main, and we assume that from the tar we release the light hydrocarbons which have been dragged down by the heavy tars in their condensation.

The President—What particular scrubber do you use?

Mr. Stedman—This hot scrubber is the Smith & Farmer scrubber. Mr. Floyd made it for us.

IN MEMORIAM.

Mr. Helme—It is my sad and painful duty to call the attention of the Association to the loss of two of our members during the past year—Mr. Henry Budd, of Philadelphia, and Mr. Henry Cartwright, of the same city. I was very well acquainted with both gentlemen, and feel very sadly their loss. They were good citizens and good men. Mr. Budd was the President of the Northern Liberties Gas Company for about a quarter of a century. He was a man of considerable prominence in Philadelphia, and a very pleasant, genial gentleman. He lived to a good old age; and during his long life had taken an active part in affairs of interest in that city. To him is the credit of being the founder of the Philadelphia Corn Exchange. He was very actively engaged in the management of the Penn Township Bank, and was, as I have stated, the President of the Northern Liberties Gas Company. He was also President of the Green and Coates streets railway company, Vice-President of the Philadelphia County Insurance Company, and at one time a member of City Councils. He was not generally known to the members of the Association, having been a member for only two or three years, and being of advanced age did not attend our meetings, although he always seemed greatly interested in our proceedings and in the success of the Association.

As regards Mr. Cartwright it was different. You all knew him and recollect him well as a genial, pleasant gentleman. Meet him where you might, and under what circumstances, you found him a man in every sense of the word, and his loss cannot fail to be keenly felt by all of us. I do not know that I ever had a more severe shock than the announcement made to me one morning that he was dead.

As we meet in convention year after year we have each time to learn of the death of some one of our relatives and friends. We entertain the hope that next year this will not be the case, but as the year rolls around again it becomes our painful duty to notice the death of some one or more of our number.

I knew no one else of his age who had a fairer prospect of length of life than had Mr. Cartwright. He was even-tempered; genial and pleasant in all the relations of life. He had a large circle of acquaintances, many friends, and was a very useful citizen. I have been associated with him in matters concerning the prosperity of various institutions in Philade phia, but more particularly the Franklin Institute, of which he was one of the vice-presidents, and myself a director, for many years. He was one of the most useful members of that Institution, and in his death it has sustained a great loss. I saw him only a few mornings before he went up into the mountains of Pennsylvania, and I never saw him in better health or spirits. His death suggests to us that we should heed the Divine admonition, "Be ye also ready," Ten seconds before the accident happened to Mr. Cartwright I suppose he had no more idea of dying than any one of us now have. The accident was caused by a very trifling oversight, the details of which I need not relate. He was away partly on business and partly on pleasure. He lived for some hours after the accident, but unfortunately not long enough for the telegram to reach his family and enable them to get to his bedside before he passed away.

Mr. Cartwright's father was one of the incorporators of the Northern Liberties Gas Company. The Cartwright family, many of whom you know, consisted of ten children, five sons and five daughters. They were all born in the limits of Philadelphia, except Henry, who was born in the city of Wilmington, during a sojourn of his father and mother. The father and mother are dead, but Henry is the first of the ten children to pass away. It is fitting that in some proper way we should tender our sympathy to his sorrowing family, and record our own sense of bereavement at his untimely fate. I, therefore, move that the matter of obituary notices be referred to a committee.

Mr. Nettleton—Before that motion is put I would call attention also to the death of Mr. Butler, of Meriden. He was a member of our Association, and died last July. I would include his name in the resolution of reference.

Mr. Helme—I accept the amendment.

The President—The course taken last year was to request the Secretary and President to prepare obituary notices of deceased members, and incorporate these notices in the printed volume.

Mr. Helme—I accept the suggestion. That is the better way of doing it, as the volume will probably be published and distributed before the next meeting. I, therefore, move that the President and Secretary of the Association be requested to prepare the proper obituary notices of Messrs. Budd, Cartwright and Butler, to be incorporated in the next published volume of proceedings.

Mr. Butterworth—Is it not customary for the Secretary to communicate with some friends of the deceased and ask them to prepare the notice? Then the friends can put in what they know about him. I think that I received a notice of that kind from the Secretary year before last.

The President—That was the way in which the Secretary gathered the material, and then put the obituary notice in his own language.

The resolution of Mr. Helme was adopted.

The President—If there is nothing further to be said upon this subject, it will be well to follow it with Mr. Greenough's paper on furnaces.

Mr. Greenough then read the following paper on

GENERATOR FURNACES.

Mr. President and Gentlemen:—It is with some hesitation that I offer you a paper so egotistical as this, but I pray you to excuse it and look on it only as a record of one and a half years' experimenting. It is only as such that I commend it to your notice.

A year ago last February I had the pleasure of reading to the New England Association of Gas Engineers a paper on Generator Furnaces. At that time I had been reading the subject up a little, and had visited Baltimore to see the Dieterich furnace, and I thought I knew something about it. So I did; but not much. Last winter I had some practical experience which was not altogether favorable, and came to the conclusion, as often before, that I had not mastered the whole question, and that it was not all plain sailing by any means. Being anxious, however, to increase my stock of information by seeing what was the actual experience of other people who had been working longer upon the subject, I was allowed by my directors to take a hasty run through Germany to see what was being done and how far their experience there differed from or agreed with ours.

Although the Paris works used generator and recuperative furnaces many years before any German works, yet it is to Germany now that we have to turn for the most careful experiments on the subject, and the most efficient application of the principles discovered. Schilling, Hasse, Goldbeck, Oechelhauser, Liegel, Klönne, all are Germans, and whatever is to be learned on the subject can be got from their settings and experiments. By this I do not mean to speak with anything but praise of the Siemens system, but I think equal or better results can be more simply obtained. Nor is this statement any exception to the general rule that no subject relating to gas manufacture can be thoroughly treated without mentioning the name of Livesey. His ingenuity and originality call for undoubted praise; but he would not himself claim, I think, that his experiments in this direction had been crowned with entire success.

In making this trip I was very fortunate in being in admirable company. Circumstances happened to send M. Monnier and M. Thibaudet, two well-known French engineers, upon a similar tour of inspection; and I owe it to Major Dresser that I was enabled to join the trio of which he was the third. Together we visited the principal works in Germany and Holland, and after getting all through I appreciated the fact that there was still much to be learned, and that a gas furnace was not to be satisfactorily built and run without a great deal of care and brains being put into it by somebody. After, however, you get it properly working you have a machine which is a great improvement on the present system of heating; but there is a long step to be taken by the ambitious engineer before he reaches perfection. In my travels to the various works I noticed with pleasure that they also knew what it was to clean a standpipe. I was gratified to find an arrangement in operation at one large works by which the pitch could be removed from the main without stopping the working—showing their acquaintance with that valuable product. I was charmed to learn that some patentees of furnaces were not able always to give satisfaction to the users.

These things, I say, encouraged me, because if, in spite of them, they had persevered to a satisfactory condition of affairs, it showed me that we should not be downcast at any want of immediate success.

I do not propose to read a paper going into details of the principles involved. It would require much too long a time, and to gentlemen of our profession who read the current literature it would be not only a twice but a twenty times told tale. Everybody knows that in a perfectly working furnace carbonic oxide must be first formed and then combined with oxygen from superheated air. That this air should be superheated by waste products if possible is obvious.

That to insure the best results analyses should be occasionally made of the spent products is also obvious, or else you cannot know how complete is your combustion, or if there is a leak in your walls or superheaters. You must, of course, guard against radiation as much as possible. You must build your furnace deep enough and charge it often enough to keep always a quantity of coke sufficient to make carbonic oxide, and not to make your complete combustion in the furnace itself. You must arrange for the introduction of steam or water at the bottom sufficient to prevent the eating away of the tile by the heat.

And, finally, what have you got? You have a retort which is able to produce 60 per cent. more gas, and which will last 15 or 20 per cent. longer than it did before. So the German engineers all agree, though I cannot say that it is our experience yet. You can do this by the use of about 15 or 16 pounds of fuel to 100 pounds of coal carbonized; which, reckoning the

coke saturated and dried to weight 70 per cent. the weight of the coal, would give about 21 per cent. of the coke made. I have occasionally heard such extraordinary tales of the small quantity of coke used in ordinary fires that I do not propose to say what a proper amount is. The only way a large company can calculate its consumption of coke is to deduct what it sells and uses from its estimated production, determined by experiment; and it will make much difference whether you consider your make per ton 36 bushels, as some do, or 42 bushels, as we do in Boston. If there is any person here, however, who can get up a heat sufficient to work off 10,000 or 11,000 feet per retort with one-fourth of his coke, or double that quantity, in an ordinary setting, I should be pleased to hear from him. I am inclined to believe that what would be called a low heat can be maintained by a proportionately less quantity than is necessary for a high one; but if you want high heats by an ordinary setting, you cannot spare your coke.

Let me now call your attention to one or two things which I did not appreciate before.

It is obvious to whoever gives an examination at all scientific to the matter, that in heating anything there must be a waste of fuel if it is necessary to raise the temperature of a great deal of superfluous air. Everybody remembers, when it is brought to his attention, that air consists of 21 per cent. O, and 79 per cent. N. When this burns up carbon, the resultant gases are 21 per cent. CO_2 and 79 N. If you produce just this, you have perfect combustion in the most economic way; but if you find, in analyzing your products of combustion, that only 10 per cent. is CO_2, for example, then you have obviously got twice as much air in your fire as is necessary, and every foot of it must be heated up to the temperature of the retorts with a consequent loss of the fuel required to do it.

This is the whole principle of a generator, and is the economy of heating by gas because it is much easier in this way to use just the proper quantity of air. It of course has nothing to do with *re*-generation, or the use of the waste heat; but the additional economy to be so gained is for us certainly not nearly as great. The best regeneration is not considered to save the use of more than 2 pounds of coke per 100 pounds of coal; whereas the use of gaseous fuel would save to most of us who run good heats at least four times that percentage, and probably more.

Most companies in this country use about 40 per cent. of the coke made to heat their fires; or on the theory that the coke weighs 70 per cent. of the coal and, by the Continental method of figuring, 28 lbs. per 100. By using gas properly it can be done for 16 or 17 lbs., and by utilizing the waste heat as much as possible for 15 lbs. At Munich 14 is claimed; but, combined with the use of large quantities of water, I doubt if it is possible to produce a fire by coke alone which is as hot as a generator fire, even if 50 per cent. of the coke should be used; but allowing that to be the case, and using only 40 per cent., you can save 10 lbs. of coke for every 100 lbs. of coal used, quite a pile at the end of a year. I do not mean to say that I have been able to do this yet, but I have no doubt it can be done. We have, however, done better than with the ordinary furnace—very much better.

In place of 28 lbs. of coke per 100 we get a much higher heat with 21 lbs., and this comes chiefly from the saving in the use of air. I have had a number of analyses made of the waste products of these furnaces, and although they do not work to perfection, yet when they are compared with an ordinary fire the difference is apparent. Out of several analyses made in a common fire the best percentage that could be obtained for CO_2 was about half a hour after filling, and was 14.77 CO_2, 5.53 O; but before filling it was found in one case to be 3.56 CO_2, 17.24 O. To take it at 6 per cent. CO_2 before the furnace has been filled, 12 per cent. after is, on the whole, I think, a fair representation. That is to say, there are more than three times as much air as is necessary in the first place, and nearly twice in the second. In fact, this is a favorable representation, for the CO_2 has been found by us, even after the furnace was filled, to be 8.68 on one occasion and 6.1 on another. Now, as every pound of carbon requires about 12 pounds of air to properly consume it, it makes some difference whether you use the right amount, or twice it. I think that, even with these furnaces, it may be said that, at their worst, they are as good as an ordinary furnace at its best, and at their best they are very much superior. A statement of an experiment made Oct. 11th, with a fire of six retorts, is of interest—

Coal used, 90 *per cent. Penn*, 10 *per cent. cannel*; 2,000 *lbs. for six retorts* —15″ × 26″ × 9′. *Two charges of four hours each.*

Gas made.....10,300 feet
Gas made.....10,700 "

or an average of 5.25 feet per pound.

Temperature of middle retort at end of each charge, 2240° *and* 2400°.

Three tests of waste gases gave:

CO_2	O	
17.32	3.2	about an hour after filling
18.6	2.2	" " "
16.59	4.28	" 20 m " "

quantity of coke consumed a little less than one-third—say 21 lbs. per 100. I am firmly of the opinion that if we had room in the arch to set one, or even two more retorts, we could heat them sufficiently without the use of much more coke, and I am sustained in that opinion by one of the most eminent German engineers, whom I heard make the statement that when he removed the fireplace from the front of the bed he found room for two more retorts, and that he could heat them with the same quantity of coke necessary to heat six previously. We are constructing some furnaces on his plan in the rear of a single stack, but are unable this year to enlarge our retort rooms.

Next year I shall try to do so, however, and shall be disappointed if we do not reduce, by several pounds, the percentage of coke required to heat them.

The furnaces are also made high so that there shall always be sufficient depth of coke for the air to rise through before getting into the setting, for that is an undoubted advantage, and in two tests taken of gases from a furnace made somewhat deeper than that previously quoted, we obtained on October 12, in first test, CO_2 19.07, O 1.12; and in the second, CO_2 19.24, O, zero. The first showing almost complete combustion, with a trifling excess of air, and the second a small deficiency of air. The heat of this fire is somewhat more even also, and the furnace somewhat cooler. It may make the records somewhat more complete to state that an experiment showed the draft in the outlet flue to be 3 thirty-seconds of an inch, and the temperature of the escaping gases to be 2300°. I do not at this time propose to go into an account of the different ways in which the various European engineers have worked out the problems set to them. They are all working on the same principles most of them with good success. Personally I do not feel entirely satisfied yet, but at the same time much progress has been made, and we feel encouraged to persevere. We have certainly overcame many of the difficulties which have been in our way from time to time. It was said to me this summer, by a foreigner, that "I must either learn this system myself, or pay somebody to *do it* for me. If possible, I propose to learn it myself, and if we do succeed in getting the better of various troubles, the difficulties of which are fully appreciated, I shall perhaps call the attention of the Association to the fact, for in spite of the criticisms of this whole system, which are not uncommon, I am strongly of the opinion that gas is the fuel of the future for retorts, as well as for stoves, and shall therefore take it for granted that the result of experiments in this direction will be of interest to the gas community.

Discussion.

Mr. Butterworth—Do I understand those to be the actual working facts with regard to the furnaces spoken of?

Mr. Greenough—Do you mean the figures which I gave? Yes; those are the actual working figures. I suppose that the retorts which we have had in use are making in the vicinity of 11,000 feet, and have been doing so right along.

Mr. Butterworth—You spoke with reference to 12 pounds to the 100 being such a small percentage. It is less than is ordinarily allowed. I have noticed that the superintendent of one company in London always brings in such reports as those at the meetings of the engineers; but they get up and tell the stockholders that 12 per cent. is not by any means a large quantity to use.

Mr. Greenough—I did not make the statement of 12 pounds to the 100. The best figures I ever heard of were 14 pounds to the 100.

Mr. Butterworth—The statement that I read was 12 pounds to the 100; but I read in the report of the meeting of that same company that one of the stockholders asked what became of the coke if they only used 12 pounds. The engineer said that 30 per cent. of all the coke made was not too much to be used.

Mr. Littlehales—Referring to the statement made by a previous speaker, as to the difference in the fuel account on the other side and in this country, I think the explanation is due, to a very considerable extent, to the fact that tall chimneys are invariably used in England, but almost invariably dispensed with here. My own preference is entirely in their favor. I think it is obvious to almost everyone who goes into a retort house on this side, and sees the great amount of flame escaping from the top of the arch, that there is a great amount of heat wasted there. As matter of fact, there is probably, in many cases, one-third of the fuel being expended at the outlet of the arch instead of doing duty inside of the arch. Another reason for the high fuel account is this—that, as a rule, the furnaces are too wide at the bottom. I have seen many furnaces which averaged 12 and 14 inches wide. If they were reduced to 6 or 7 inches there would be a great saving in fuel as the result. I know that in many of the works in Great Britain a large amount of the saving effected has been attributed to that fact. A simple reduction of the width accomplishes it. When the fire gets low, a great deal of the fuel is taken up to heat the enormous amount of air that is passing through the furnace. In many cases I think that the fuel might

be reduced 10 or 15 per cent. by making the furnaces narrower at the bottom. I make it a rule never to exceed 7 inches in the largest furnaces that I build. I put in two furnace bars. I reduce the amount consumed very considerably; so much so that the stokers can tell the difference in a moment. If my friends would try that plan, I am sure they would find benefit resulting from it.

Mr. Greenough—I would like to say to the gentleman who has just sat down that I think he is perfectly right about that. Experiments made by us convinced me that there is too much room at the bottom of the furnace. But he must remember that American works are generally run without high chimneys; and that therefore a 7-inch furnace would not give draught enough to consume the proper amount of coke for heating the retorts to a high heat. You can run a narrow furnace with a high chimney, but I do not think that you can without.

Mr. Littlehales—And therein comes the commercial advantage of a high chimney. I think that a high chimney is of great advantage to a company.

Mr. Rowland—I would like to ask the gentleman the width of his furnace, what percentage of coke he uses, and what yield he gets from his coal. I think that all those facts should come in in figuring between a 7-inch and a 14-inch furnace.

Mr. Littlehales—That will depend upon the number of arches working at a time. Everyone knows that if you are running half a dozen benches side by side, you use considerably less fuel than if running only two. Our works are small, and generally we are not running even three or four benches. I am perfectly satisfied that it will make a difference of 10 or 15 per cent. under any equal set of conditions, whether you have half a dozen benches or a single bench; and that the mere narrowing of the furnace alone will reduce the fuel account to a very much larger extent than most of us are aware. In small benches I never put it more than 5 inches; I have made them as narrow as 4 inches. They have the great advantage of not allowing so much air to pass through. Of course you cannot do that without a chimney. The chimney has the effect of an exhauster. I am perfectly satisfied that a high chimney is of very great advantage.

Mr. Rowland—I would like to have some figures from Mr. Littlehales.

Mr. Littlehales—About 25 per cent. of the coke made.

Mr. Rowland—How much gas do you make per retort?

Mr. Littlehales—The general run is 6,000.

Mr. Rowland—What is the size of your retorts?

Mr. Littlehales—21 by 15 inches.

Mr. Rowland—We want all of those figures put together to make up the result.

Mr. Littlehales—That does not affect the question of fuel. The amount of gas you make out of the coal does not affect the fuel question.

Mr. Rowland—I think it does.

Mr. Littlehales—I think not, because you have a great deal of heat wasted at the outlet of the flue. I do not see how it affects the quantity of gas produced per ton.

Mr. Rowland—We do not want to waste that fuel.

Mr. Helme—Do you retain the same depth of fuel?

Mr. Littlehales—Precisely the same—simply contracting it. As a general rule the pit would be one foot wider, or just a little over, so as to bring it to a level with the furnace bars. In a bench of six or seven, I make it 7 inches wide and then open it out again. I just corbel it over and bring it to the furnace, and then open it out again.

Mr. Helme—I saw that tried twenty years ago, and it was not such a success as Mr. Littlehales represents it. It may have failed because they had not a chimney for each stack. I saw that tried in this country twenty years ago, where they brought it down to 3 inches in width at the bottom, with an opening 1½ inches square; but they abandoned it finally. They found that if they burned as much coke as they did the other way they did not get any better heat, and that it was more labor for the men to keep it up. It may have been due to the fact that they did not have a high stack, which would have given a better draught. Of course, the amount of air passing in depends upon the velocity.

Mr. Rowland—I simply asked the question of Mr. Littlehales, to see what he would do with a fire box of that dimension; because I think that the results obtained from fire boxes of different sizes should, perhaps, all be put together. How much coke is being used? What gas is coming from the retort, and what from the coal? These questions should be grouped together; and added to them should be the question, What is the candle power of the gas coming from the coal? If we can do as well with a 7-inch furnace as we can with a 17-inch, use 40 per cent. of the coke, and get the same result in every way, I think it is very desirable to know that fact. To determine the question we should have all of these figures in connection.

The President—There is another element which should be taken into consideration, and that is the kind of cannel which is being used.

Mr. Helme—I think it is very evident that Mr. Littlehales does not get the best results. He gives the size of the retort and the amount of coke used. His retorts are all large. He says that he gets 6,000 feet per retort, and uses 25 per cent. of the coke. That is not a bad result.

Mr. Littlehales—I think that the gentlemen make a mistake in supposing that there is a direct connection between the amount of coke used for fuel and the amount of gas produced per retort. As everyone knows, the quantity produced per retort varies very much. The quantity depends upon a dozen different conditions. When the retorts are new they will yield very much more than they will when they get old. You cannot bring them all down to any particular standard. It depends greatly upon the condition of the retorts. If they get cracked, a great deal of gas will be wasted. The fuel used has no particular connection with the amount of gas made per retort.

Mr. Helme—There is certainly one advantage in that kind of furnace, and that is this: that as the furnace gets old, and you have to clean out the clinkers, you have to work on them a good while before you get them out, and if you start with a 12-inch furnace and keep on until you get it to 14 or 16 inches, you may know that you are getting in under the retorts, which is a bad thing to do. If you have the kind of furnace that Mr. Littlehales speaks of, you have several inches to work on before you get to that point.

Mr. Littlehales—I am convinced that if either of you would try it you would be satisfied with the result.

Mr. Butterworth—I think I am doing pretty well if I can sell 60 per cent. of what I am making. We have pretty large furnaces, and when we fill them we fill them! I keep out all the cold air that I can from the furnace, excepting what is run back and forward through the retort. I have never found a man who got over 16, 20, or 25 per cent. I have stated this at several meetings which I have attended; and I would like very much to hear from someone who has done any better in this respect than I have.

Mr. Armington—I think that our friend Mr. Littlehales is on the right track, as the experience of the last speaker would seem to indicate. He says that when he narrowed up the bottoms of his furnaces he had to open a flue under his retorts to get air enough in there to make his fire burn. The truth of the matter is that he just opened those flues to let in sufficient oxygen from the outside to consume the carbonic oxide that he had made. That is only another argument in favor of narrowing the furnaces at the bottom. Mr. Livesey has carried that thing almost to the point of perfection. We hope that we are on the right track ourselves. If he narrows up that furnace, keeps the oxygen out from the bottom, generates carbonic oxide, and then lets his air in and burns it up, he is all right, for he gets the benefit of the heat. We are trying to do just the thing that our friend Mr. Butterworth used to do. He says that they used to open the flue and let in some air to make the fires burn; but he simply burned up the carbonic oxide. We are trying to keep out that air, and not allow it to go in underneath, except so far as to complete combustion. Looking into the fire, you distinctly see every piece of coal in it. It is not in a solid mass, but every piece is distinct and separate, showing that it is giving off all of its gas. We get, by our present plan, the same result that my friend got by opening the flues and letting in and burning the cold oxygen.

Mr. Butterworth—I did not say that I opened the flues. I merely let in the cold atmospheric air behind the flues, ran it away back for seven or eight feet, and then brought it back again. I brought it in just on a level of the retort. That made my fire burn. I had iron retorts in those days; and I lost my retorts by doing it.

Mr. Wood—I have had a little experience in this matter, although not very satisfactory in some respects. For the last six or seven years I have been using a fire place seven inches wide at the bottom, and four feet grate bars. My fire places are 20 inches wide at the top. I put them in beveling on the sides. They are beveled off to twenty inches; and they are twenty inches deep. We have short chimneys. We did not get draft enough. This season I have set two benches with flues beside the ash pan, and just below the fire, running back into the bench, turning up back, and then going through the back side of the fire place, about a foot above the fire, and right over it. I get draft enough now. I get air enough to burn my fuel, and to get a good heat. I do not get a good heat on my lower retorts, and cannot. I do not know how to do it. We use small retorts, six to the bench, with 180 pound charges; and on three benches we make 99,000 feet, or 33,000 feet to the bench, or 5,500 feet to the retort. Our gas is made entirely of coal. We use no enricher. We use Penn and Kanawha coals—two thirds Penn and one third Kanawha, and we get 5.10 to the pound, of an average of 18 candle power. If we could get our lower retorts as hot as we do the upper ones, we could make a considerably greater quantity of gas; but we cannot do that.

Mr. Armington—Do you use the same kind of scrubber as our friend from Newport does?

Mr. Wood—We do not.

Mr. Armington—It seems that my friend, Wood, gets the same candle

power out of the coal alone, without any enricher, that my friend from Newport gets with an enricher. He evidently puts it in with his scrubber.

Mr. Stedman—It is some time since my friend from Brooklyn moved from Rhode Island, and I fear that he has lost his faculty for figuring. (Laughter.) That may mitigate the statement I have made in the minds of some of the gentlemen. Perhaps I ought to have prefaced my remarks by the state ment that we gentlemen who reside in the vicinity of Boston belong to what is known among ourselves as the Guild of Gas Managers. You may have seen the cards here to-day bearing the device "G. of G. M." That is the technical meaning of the letters. There is a jack-knife belonging to the club which is to be given to the man who makes the best showing of results, either mentally or any other way. There has been a good deal of figuring among the members of the Guild to get that jack-knife; and I do not know but that I may have been led into mis-statements in my anxiety to get the knife.

I merely arose to say that we work through an eighty-feet chimney. This chimney was a legacy left to the works, by the party who built them in Newport, twenty-eight years ago. The works were built without any particular regard to cost. They were built very much larger than there was any necessity for then. This chimney is rather a feature of the architecture of the place. It is a very handsome, tall and beautifully built chimney. It is eighty feet high, and gives a magnificent draught. We attribute to that high chimney, in some degree, the intensity of the combustion which we secure.

Mr. Armington—I think my friend from Newport has explained the whole thing. There is no doubt that the increased candle power is due to that handsome chimney.

Mr. Stedman—The gentleman from Brooklyn was considerably dazed at one time by the luminosity which I shed upon him at one of our meetings of the New England Gas Engineers, in which I remarked about his own intensity in the combustion of gas in Argand burners; and since that he has never been able to see clearly when looking in my direction. (Laughter.)

Mr. Greenough—I would like to ask Mr. Stedman what sort of a draught his chimney has, if he knows?

Mr. Stedman—I do not know exactly the draught.

Mr. Littlehales—I tried our chimney a while ago. It is eighty-four feet high, and there was a vacuum of three-fourths of an inch. I think the highest that it is possible to obtain does not exceed one and a-half inches. Ours is 84 feet high, and gives three-quarters of an inch.

Mr. Greenough—This matter has taken a turn which I think is very useful; and it shows how when you pursue one subject you are very apt to gain valuable information on another. I had no idea, in starting into this matter of building furnaces, that I should be gradually brought around to the conclusion that we were all working on wrong principles in the matter of fire-boxes. I found, on the other side of the water, that the principle of high chimneys was almost universal; and that the use of narrow fire-grates was almost equally universal; and that the percentage of coke consumed under the fire was very much less than it has been here. When you come to look at the matter scientifically, and analyze your resultant gases, you will be surprised at what you will find. The results which we obtained from our works in Boston have been found as high as seventeen per cent. of free oxygen, which shows what an enormous waste of fuel there must be in the use of the wide fire-boxes, with such an enormous quantity of air passing up through. The chimneys which are generally used abroad are about 75 to 80 feet high, and they give a draught of about three-quarters of an inch. We constructed an apparatus (which is very delicate) for the purpose of testing our draught, and to our surprise we found that the draught in our Dieterich furnace (although the furnace was so hot) was only a little over the sixteenth of an inch—about 3-32. In an ordinary fire, where the heat is not so great, the draught would not probably exceed the sixteenth of an inch. A sixteenth of an inch of draught is not sufficient to pull the requisite amount of air through a fire-box which is only six inches wide. If you have three-fourths of an inch draught you can keep a much deeper layer of fuel, and get a much more satisfactory combustion in the furnace. The experience of Mr. Littlehales corroborates what I have been led, through the experiments which I have made, to believe would actually be the case.

Mr. Littlehales—There is another view of the question which is important, and that is the fact that the fronts of the benches are cooled much more where there is no chimney than where there is one; because the heat escaping from the tops of the flues causes such an enormous draught that a great deal of cold air is brought in. In our northorn section bringing in air at 20° below zero is a very serious matter, and you cannot avoid an enormous amount being drawn in when the heat is escaping at the top. There is another consideration in favor of high chimneys—and that is the sanitary view of the question. I am not sure that a gas company is justified in deluging the atmosphere about its works with a flood of carbonic acid gas. I am not sure whether a gas company could not be compelled to carry its chimneys sufficiently high not to pollute the atmosphere with the escaping gases. I think, for sanitary considerations alone, that a high chimney is a great advantage, especially in a crowded district. On the other side there are certain regulations about chimneys. They are not allowed to let the gas from the furnace escape except through a chimney sufficiently high to prevent the gases polluting the atmosphere.

The President—We would like to hear from some of the other gentlemen. This discussion is very interesting and profitable.

Mr. Stedman—The subject is one in which I have taken a great deal of interest although, up to the present time, we have not adopted any of the recuperative styles of furnace in our works. We propose to do so this winter. It is something that we are all coming to very rapidly, because it is the only scientific way of consuming the fuel in the most economical manner. The way in which recuperative furnaces are arranged admit of a proper adjustment of the air supply to the furnaces, and also to the supplementary combustion chambers above the coke. The experiments which have been made by Mr. Greenough, in determining the products of combustion, are very interesting indeed; and they point to the possibility of attaining as nearly to a theoretical efficiency in the consumption of fuel as it is possible for us to attain in any furnace that we may adopt. It is an extremely interesting subject for discussion; and we are all obliged to Mr. Greenough for giving us the text so faithfully as he did.

Mr. How—I would like to inquire whether there is to be any particular location of that furnace with reference to the retort? Is it, as in the furnace constructed at Baltimore, located far under the bench, or is it located at the bottom of the retort?

Mr. Greenough—The furnace that we have been using is the Dieterich furnace.

Mr. How—I speak more particularly of those in Germany, which you have referred to in your paper.

Mr. Greenough—In Germany the furnaces, as a rule, are outside of the bed. The best furnace I saw anywhere was that made by Mr. Schilling, in Munich, which is entirely outside of the bed, below it, and connected to it by a small flue. With that furnace they were obtaining very admirable results with the use of 14 lbs. of coke to 100 lbs. of coal. That is, they were using about twenty per cent. of the coke made. Besides using the waste products of combustion to heat the incoming air they were also passing them forward under the ash-pan to distil the water from the ash-pan, and use that in the furnace, carrying the heat from the grate bars up into the interior of the fire place, where it was wanted. They were using seventy per cent., by weight, of water, to the quantity of fuel they were using, as well. The furnaces of Mr. Goldbeck, and of Mr. Hasse, were also outside and below them; but Mr. Liegel and Mr. Klönne both have their's partly inside the bench. Mr. Oechelhauser has his furnace outside of the bench and at the rear. There was comparatively little excavation made for his furnace. It was practically outside of the fire place. All of these gentlemen are doing about the same thing. They are using from fifteen to seventeen pounds of coke to 100 pounds of coal. When they talk about percentages on the Continent, they always mean so many pounds of fuel to so many pounds of coal carbonized. That was a misunderstanding into which I fell in the discussion held in Boston a year ago, in which I said that the Paris company were using fifteen per cent. That was an error. According to our method of figuring fifteen per cent. is twenty-one per cent. They are getting that by the use of gas as a heating material, and also by recuperation. Mr. Stedman just alluded to a recuperative furnace. Now, the Dieterich furnace is not, in any sense, a recuperative furnace. It is a generator, that is all. Its chief economy is by the use of the generator. Any heat which passes in by the side of the Dieterich furnace, through the air flues, is simply robbed from the furnace itself; and the waste products of the furnace are not used at all in recuperation. Most of the German furnaces make use of recuperation. I admit that I had not appreciated how little value recuperation held as compared with the use of gas. If you use a good generator you should be able to heat your retorts with 16 or 17 lbs. of fuel. The best recuperation will not reduce that more than ten per cent.—less than 2 lbs. So that it may be worth while for a man to spend considerable money for the purpose of putting in good generators, and yet be worth very little to him to spend money in recuperation. It is a matter that a man can figure for his own company—how much it will pay him to spend for recuperation, according to the value of his coke.

Mr. How—I would like also to ask Mr. Greenough whether he has measured the temperature of the air passing into the top of the furnace.

Mr. Greenough—Not through the Dieterich furnace. Some have been able to do so. The best recuperation they have been able to obtain reduces the temperature of the out-going gas about one-half. If the out-going gases have a temperature of about 2000°, they have been able to reduce it to about 1000°. I presume it would be at about that temperature when it entered the furnace.

Mr. How—Then they would get a temperature of about 1000°?

Mr. Greenough—I would infer that; although it would be very difficult

to test the temperature just before the point of combustion, for there it would be very high.

Mr. How—I feel greatly indebted to Mr. Greenough for his paper. It seems to me to be a subject of the greatest importance to the gas interest in the reduction of the price or cost of gas, to so construct the furnaces that we will get the best yield from the retorts and from the coal supply, with the least possible expenditure in that direction. I am, perhaps, hardly to be classed among gas engineers, but I have nevertheless given a good deal of personal attention to the retort house; and I know that the use of this furnace, or of something akin to it, gives far less labor to the men engaged in the work. As my friend and Associate, Col. Armington, has stated, he has now in progress some experiments which will, I trust, produce the results which he claims they will. It seems to me that something more needs to be said with regard to the construction of furnaces and the proper location for them. It was with the view of calling out the opinions of gas engineers on that point that I asked Mr. Greenough whether it should be placed under the retorts. It seems to me that my friend who complained of a difficulty in his furnace, could easily surmount it by depressing the furnace, and so bring the products of combustion against the bottom. It seems to me that, at least, the experiment is worth trying. These and kindred questions are of great practical importance; if the members would freely communicate to the Association the practical results derived from their own experience, they would be of very great value to us all. In meeting the contests of to-day, with oil at so low a price as to be almost the illuminator of the world, with the exception of the great cities, and with (as a clever writer says) that cantankerous fluid, electricity, staring us in the face, and with plenty of money for its development at hand, we need not feel greatly disheartened so long as the coal pile is the common resort of both of us; and I have no fear but that gas will maintain its position, as we all desire. (Applause.) Yet it becomes us in meeting the public, in meeting large communities like these great cities, to produce gas at such a price as shall make every consumer our friend, and as shall induce a much larger consumption than at present. It is to that point that it seems to me the exertions of this Association should tend; and we should all strive to produce gas of uniformly excellent character, and at as low a price as is consistent with reasonable dividends to the stockholders.

Mr. Greenough—Mr. How's remarks have brought to my mind the fact that there is something which I would like to add to what I have already said with regard to that matter. Mr. Livesey has put his furnace inside the bench, and the arrangement is, as I understand it, somewhat similar to that with which Mr. Armington is experimenting. I called at Mr. Livesey's works and saw the furnace which he had erected. Possibly gentlemen may not have become informed of the type of furnace which Mr. Livesey is using.

The Germans, in experimenting on this matter, have found that there are two or three ways in which they could build the fires: First, of course, with grate bars such as we are using. Then it was discovered that the coke would fuse and run without the use of any grate bars, a proper quantity of air being admitted through a small slit in the bottom of an arch underneath the furnace. I saw some large furnaces, heating sixteen retorts each, that were made in that way and working well. It was found, however, that all cokes would not work. It was found that some cokes had too much ash in them to fuse and run; and it was found necessary to put a small fireplace with grate bars underneath the slit. Then they went to building fires directly on an open hearth, with no slide or grate bars. Furnaces built in that way are working admirably. One of the best furnaces that I saw, which was in Dresden, was working entirely in that way. Mr. Livesey has erected his furnace on the slit plan, trusting to the coals and coke to fuse. I believe that their coals and coke do fuse tolerably well in that way. Whether our American coals would fuse properly can only be determined by experiment. I think it is more or less doubtful. Mr. Livesey then introduced his air flues through the side of his bench, bringing them in at the center and rear, where they would meet the in-coming carbonic oxide. But he melted off some of the ends of his flues, and could not get at them satisfactorily. The furnaces which I saw working on Mr. Livesey's system were not such as would commend themselves to Mr. Armington for heats. It is possible that further experiment will enable him to improve them; but those that I saw I did not consider a success. I look upon any furnace which is built inside of the bench, where it cannot be got at, as a very doubtful one. I think that the experience of retort builders on the Continent is to the effect that you had much better disconnect your generator from your retort stack. It costs more, in the first place; but afterwards you can fix your retorts without disturbing your generator; and you can fix your generator without disturbing your setting. I should prefer one constructed on the outside to one constructed on the inside. But it is a matter entirely of experiment, and it may be possible to arrive at some very simple method of attaining the desired result. I look upon the whole matter, however, as experimental at present.

Mr. Stanley—I will ask Mr. Greenough whether the difficulty referred to did not arise from the iron pipes.

Mr. Greenough—I do not think that it did altogether. My impression is that there was some stoppage in the pipes as well, which he found it impossible to get at and clean out.

Mr. Weber—I have some drawings of various kinds of furnaces, which I would like to show if desired. Mr. Greenough can explain from them what he wishes.

Mr. How—I think I understood Mr. Greenough to say that it was the furnaces which were built outside of and beneath the benches, which produced the favorable results which he has given.

Mr. Greenough—They were beneath the floor, not beneath the bench.

Mr. How—But decidedly underneath the retorts?

Mr. Greenough—Yes; independent and under. The bench which has given the best result has been one in which the generator was entirely outside. The recuperator system has been underneath, and the generator has been outside and below.

Mr. Page—It is known to some members of the Association that Mr. McIlhenny, whose absence we very much regret, has for six months past been making practical experiments with a generator furnace, containing six retorts of such a size that he is placing in them 300 pounds of coal, which he runs off in three hours, and is able to produce 72,000 cubic feet per 24 hours, at an expenditure of 18 to 22 per cent. of coke. His system is, in short, this (I may not get it correct, but I will try; this is a bench set up separately, and which has been making gas for six months): He has a boiler-shaped wrought iron apparatus over the stacks, which takes away the excess of heat. There is about 60 per cent. of waste heat which passes away below the retorts, and which, by the aid of the blower (using the blower which he had been using in his forges—an 18-inch blower), he takes the air, from the same pipe which sends it into his forge, through this boiler, which is divided by plates into three divisions—the plates extending not quite across it—so that the air passes three times through this boiler-shaped apparatus. From that it goes out, at a heat of 500° through a pipe outside of the retort, so that he gets the benefit of the heat there. He then passes the air in just below the furnace, which is below the retorts—the retorts being built on an arch and the furnaces set just under and bricked in. He supplies this with coke, from the bottom retort, by means of a shute passing directly into the furnace. He says that his difficulty has been rather too keep down the heat than to cause it to increase. I went to the top of the bench of retorts, and I could hold my hand over the small opening over this boiler iron where the excess of heat was passing away. While this was the first time that I had given any personal attention to that system, I must say that it impressed me very favorably. He desired me to say to you that he exceedingly regretted being absent; sent his kindest regards, and desired any who passed in that direction on their way home to come and see him, and he would extend to them Washington hospitality. (Applause.)

The President—I will read a letter which I have received from Mr. McIlhenny:

"Dear Sir—The experimental bench that we had built on the regenerator principle is a grand success, and I would like very much to have you stop here on your way to the Convention and see it. It will compensate you, I assure you. I think that it surpasses anything of the kind in the world. Come and examine for yourself. Yours very truly,

"Geo. A. McIlhenny."

I presume that the same invitation is extended to every gentleman here. I was not able to come that way, but I think I will go back that way and see it.

Mr. Page—The statement was made to me that they were going to put the entire retort house into that system. I will add that, in order to get a depth for this furnace, it is necessary to go down about 10 feet. That gives ample room.

[To be continued.]

The New England Association Excursion.

Anxious forecasting of the weather on the part of the Committee of Arrangements, and the forebodings of the fearful are at an end. Friday, Oct. 21, dawns bright and beautiful. There is a crisp exhilaration in the air which suggests brisk walking, and many of the vigorous members of the Association set off on foot. To some the journey proved so long that discretion and inclination joined cause with the seductive gestures of the passing horse car conductors, and they succumbed to weariness, or lack of time, and were carried. A few held out sturdily and covered the distance on foot. All arrived *almost* on time at Rowe's Wharf. A few minutes after the "sharp ten" which the committee had announced, we all are gathered on board the steamer Governor Andrew, which is to take us down the Harbor, and give some of those from the interior their introduction to "Life on the Ocean Wave." The party consists of the members of the American Association in

attendance at the Boston Convention, the engineers of most of the New England companies, and some of their directors, and quite a number of the representatives of associated industries.

That last man, for whom we have been waiting, has arrived, the gang plank is pulled in and lines are cast off. Now, swiftly down the tranquil bay, our noble steamer, on its way, with breezy motion sweeps along to its own monotones of song; of plashing wheels, and cleaving keel, and pulsing of its heart of steel. The harbor spreads its liquid miles, calm as a mirror's placidness, save where it dimples into smiles beneath some zephyr's soft caress. The hush of "Indian Summer" broods upon the sea. The cloudless sky reflects the reminiscent moods of Nature for the days gone by. And happy laugh and merry jest ring out above the goblet's brink; and happy host and merry guest pledge friendship with the crystal clink of glasses, mellow with the glow of Summer's garnered gold within—

"Deer Island! Is it possible we are there already?"

A landing is made, and the party forms in two ranks, preceded by the band, and, marching in excellent order, under conduct of Colonel Underwood, the Superintendent of the Island Institutions. The round of the different departments is made, and an opportunity afforded to see the superior manner in which the care and discipline of the establishment is conducted. Every part of the building is a miracle of neatness. The party brings up in the chapel, where a brass band, made up of boys belonging to the school, greeted our entrance with a finely-rendered piece. Afterwards there was singing by the scholars, and the manual illustration brought into play in some of their songs gave evidence of their very fine drill, and excited the warmest applause and admiration of the visitors. After a half hour spent in the chapel, we returned to the boat where, on starting off, three cheers were given for Colonel Underwood, whose skillful management, and evident great success with the unfortunates under his charge, left a deep impression upon his visitors.

The boat is now headed for Minot's Ledge Lighthouse, and soon we feel a gentle swell from the S.E. Now, there begins to be observed a slight tendency, on the part of some of the passengers, to seek seclusion and quiet; and there is a pathetic flavor in the smile which meets the kind suggestions of anxious friends. The smile grows more astringent, and disappears; while a paleness about the mouth evidences the necessity of an immediate resort to a recumbent posture Only one man, though, got a thorough surf-fit—for, passing the lighthouse, we turned toward the shore and were soon in calm water again.

As the wharf was neared, the members of the American Association called a meeting, at which Mr. How, of Brooklyn, presided. Several speakers testified their gratification at the treatment they had received from their New England brothers, and were fervent in praise of their experience in Boston. It really seemed, so great was their affection for the city, which many of them had then for the first time seen, that most of the visitors intended to cancel all other engagements and take up their abode in Boston. Resolutions of commendation were passed, to be presented to Colonel Underwood and the Deer Island authorities. Resolutions of hearty thanks to the New England Association were also adopted, to which the President briefly responded; and, as they reached the city, the meeting adjourned.

The hospitable intentions of the New England Association were happily interpreted by the able and zealous Committee of Arrangements. The foresight and excellent judgment displayed in the procuring of everything that could enhance the comfort and enjoyment of their guests, resulted in a delightful excursion, without an untoward happening to mar its perfection. The provisions for the inner man were made with admirable selection and royal abundance. The splendid band charmed all ears with its delightful music, and the perfect day crowned the enjoyment. This day will ever be one of those recalled when we join hands and sing "Auld Lang Syne."

At the wharf the party took carriages, and were driven through the beautiful suburbs of Boston, to and around Chestnut Hill Reservoir, through Brighton to Cambridge, where the drive led among the College Buildings, and thence back over the Charles River to the Brunswick Hotel, where the final handshakings and farewells were exchanged. Auf Wiederschen!

The Water Supply of Ancient Rome.

The London *Builder*, in an interesting article on this subject, contains the following:

Although there were then at Rome no sanitary inspectors, in our modern sense, Ædiles and Censors were charged with sanitary functions. It was the Emperor Augustus who first appointed inspectors of water supply and superintendents of sewers, who exercised a sort of police supervision also over the river of the city, the Tiber. The city of Rome was early provided with a system of sewers, which at first, at the time of King Tarquinius Priscus, only had the object of draining some parts (amongst them the Forum) of the city, but which later likewise served the purpose of modern sewers, that of receiving and carrying away all descriptions of refuse. Under Tarquinius Superbus this system of sewerage was completed by the construction of the Cloaca Maxima (the largest sewer), leading to the Tiber, which still exists, and, whatever be the difference of opinion as to the provision of large sewers, may well rank with the best sewers of our time, so far as regards excellence of construction. For five centuries this system of sewerage was carefully preserved, extended, repaired, and cleaned. But with the decline of the city this great work was permitted to fall into ruins, and only the principal sewer remained, which has been preserved down to our day, but choked up by mud, and at its end toward the Tiber filled up to two-thirds its height.

The second fundamental condition for the preservation of the public health, that of providing the city with an abundant supply of good water, was done full justice to in ancient Rome. When the water in the Tiber, in consequence of its contamination by the population inhabiting its banks, could no longer be used for drinking, the Censor Appius Claudius constructed an aqueduct, for the greater part underground, from Praeneste to Rome, which was called after him the Aqua Appia. Fifty years later this was supplemented by a second; and, after other seventy years (144 B.C.), by a third aqueduct, the Aqua Marcia. The latter brought the water from the Sabine Mountains, was 32 miles long, and supplied excellent water, which for centuries refreshed thirsty Romans, and which was originally constructed at a cost of 2,000,000*l.*—an enormous sum at that time. It was in ruins for many years, but was restored ten years ago, and has since then furnished Rome with its water supply.

Numerous other aqueducts, some of them very magnificent and gigantic, were built. Toward the close of the Empire, nineteen aqueducts, fourteen larger and five smaller ones, conducted the water to the metropolis. At the end of the first century after Christ ten aqueducts supplied a daily quantity of 33,000,000 imperial gallons of water to Rome. As four eighths of this volume were used by the Thermæ, or public baths, and one-eighth by the imperial palaces, there remained yet three-eighths for the use of private consumers, the quantity supplied to the two million inhabitants of the metropolis being 62 imperial gallons of water per head per day for domestic use. The water was conducted through the city in leaden or earthenware pipes. The aqueducts were fully protected by law. No buildings could be erected over them, no trees planted near them. Heavy punishment was inflicted on persons polluting the water or damaging the aqueducts or conduits. With the decline of Rome those splendid institutions also fell into ruins; but they were partly destroyed by hostile armies or besieging forces in order to compel the Romans to surrender their city.

The Fire Risk of Electric Lighting

The Boston *Globe* says: The dangers incident to the employment of electricity for illuminating purposes are being illustrated daily in all sections of the country. Only a few evenings since a man who was making a connection of the wires at the Mechanics' Fair Building was knocked almost senseless by the fluid, and another man in an establishment on Washington street was badly "shook up" by the same impartial agency. But the saddest effect of the new invention yet recorded was at the burning of a mill in Philadelphia last week, when half a dozen were killed and more than twice as many made cripples for life. Quite a serious fire occurred in Chicago the other day from one of the electric light wires in the city getting "crossed" with a telephone line. It seem that Mr. Oviatt, manager of the Telephone Exchange, noticed some smoke coming from the answering board, which is composed of brass strips one-eighth of an inch apart, two of them being connected with a key or a peg for the purpose of putting subscribers in communication with each other. In a minute or two little blue and white flames began jumping from one strip to another across the space between them. The telephone manager at once suspected a cross with an electric light wire, and the wires were immediately disconnected. Returning to the board, he saw that the transmitter was burning, the current having jumped two feet to reach it. After cutting off another wire the box was cooled by throwing water upon it. Nothing more was observed until the lapse of one-quarter of an hour, when another section of the board, eight feet from the first one which was on fire, began to smoke. The blue and white flame was seen here too. Disconnecting the ground wire ended the display, some water being used. Half an hour later the switch-board, through which connections were made with the trunk lines, commenced to smoke, the current having jumped ten feet this time. The flames ran along for two feet, and the board smoked for five minutes before the fire was put out.

This cross was a very expensive one, the damage resulting from it being the loss of a microphone and a hand instrument in the office, and about 25 feet of the Owl Club's line on the roof. The wire melted like lead. An instrument in the store of the Chicago Music Company, situated on State street was also destroyed, the induction coils on the inside melting. About

$300 will restore everything as it was. Investigation showed that a wire had been run from Willoughby, Hill & Co.'s store to McVicker's Theater for the purpose of furnishing the electric light used there a part of last week. Its use was discontinued Thursday, but the dead wire in some way dropped down on the telephone wire, the tremendous current passing through the former thus finding its way to the central office.

The Chicago *Tribune*, in commenting on the affair, says that the effect of this "cross" shows how dangerous electric light lines are. A current that will burn carbon will set wood on fire, if it is within two feet of the wire and damp, and, finding a better current than carbon, the current will take to it. If great care is not taken in stringing the lines, fires will be frequent when the electric light comes into general use.—*Iron Age.*

[From the London "Journal of Gas Lighting."]

The Report of the Board of Trade Committee on Photometric Standards.

An important document has just been issued by the Board of Trade, being the long-expected report of the Committee on Photometric Standards, appointed by the Board in May, 1879. The Committee consisted of three specialists, of whose competency there can be no question; these were Dr. A. W. Williamson, Dr. W. Odling, and Mr. George Livesey. The services of these gentlemen were rendered gratuitously to the Board of Trade. The duty of the Committee, as first constituted at the instance of Mr. Vernon Harcourt, was to inquire into the merits and demerits of the existing candle standard, and Mr. Harcourt's proposed pentane gas system. Mr. Methven and Mr. Keates subsequently requested the Board of Trade to include their proposed standards in the reference, and this was agreed to. Afterwards the Board empowered the Committee to institute a comparison between the value of the sperm candle and the new standard which might be adopted by them.

The report is an exhaustive one, and the appendix, which contains a mass of valuable experimental data, shows how thoroughly the Committee, and especially their Secretary, Mr. Harold B. Dixon, carried out the spirit of their instructions. The first and largest section of the report refers to the variations of illuminating power of standard sperm candles. It is stated that the composition of the candles accounts in some measure for this variation, the spermaceti employed as the basis of the manufacture being a mixture of fatty ethers and oil, and not a definite chemical substance. Again, an indeterminate portion of beeswax is added to every parcel of the raw material, to prevent crystallization, whereby the constancy of the melting point is impaired. Lastly, the constitution of the wick—its plaiting, and other mechanical considerations—affects the light given by a candle. In illustration of these remarks on the manufacture of candles, it is stated that "the average light emitted by the sperm candles at present in use at the official testing-places differs by this amount (between 5 and 6 per cent.) from the average light emitted by another variety of sperm candle from the same maker, also manufactured in accordance with the parliamentary definition, for the purpose of gas testing."

That is to say that, without transgressing the wording of the Acts of Parliament which define the standard candle, a hidden change in the method of manufacture, or an altered trade process, may impose grave alterations in the obligations of gas companies. Even two candles of precisely similar chemical composition and mechanical construction will give a varying amount of light, as they consume in different ways. The most extraordinary evidence of this uncertainty of the sperm candle, however, is given in the words of the report, as follows:

"In 115 determinations we found a maximum variation between two pairs of candles of 22.7 per cent. in illuminating power."

A sample of gas tested by these two sets of candles in succession would appear to be of either 12.4 or 16 candle power, according to the candles used. Another instructive example of the unsatisfactory behavior of candles in different hands is given, from which it appears that four official gas examiners tested on the same day a specially stored sample of coal gas, using the same photometer, and candles from the same selected packets of unusual uniformity. The difference in apparent illuminating power of the gas thus tested was 2.9 candles, or 17.7 per cent.

From the appendix it appears that the Committee tested a large number of candles of slightly differing construction (the differences being principally in the wick) against gas specially stored in a large holder at the South Metropolitan Gas Works. It is interesting to learn that, as tested by the most reliable means at the command of the Committee, this stored gas did not vary in illuminating power more than 0.3 of a candle during a fortnight. Strangely enough, the alteration was in an upward direction, the gas being apparently richer by the specified amount at the end of the time. This is ascribed to the increase in temperature of the air that was recorded during the fortnight, and the consequent liberation of dissolved hydrocarbons from the water in the tank. Subsequently, from the 6th of October to December the illuminating power of the stored gas fell 1¼ candles.

Section 2 of the report is very brief, and is confined to the mention of the sperm oil lamp of Messrs. Keates and Sugg. This lamp is intended to give the light of 16 standard candles, when burning pure sperm oil, with a 2-in. flame, from a circular wick. The Committee give this standard a high character for steadiness during the time occupied by the tests, but they rejected it because of the sudden variations in intensity due to the failure of the wick. The Committee, indeed, set their face against the employment of any standard which depends upon a wick—thus indirectly condemning the French Carcel standard. The appendix, describing the experiments with this lamp, states that it required to burn about an hour or more before attaining the normal 2-inch flame.

Mr. Methven's screen standard is dealt with in section 3 of the report. After briefly describing the standard, the Committee state that "the ease and simplicity of Mr. Methven's system may render it extremely useful for determining the illuminating power of gas." But the Committee consider that its utilty is confined to gas which does not ever vary in quality more than about two candles up or down. The experiments detailed in the appendix show the steadiness of the Methven standard and its freedom from interference by variations in the height of the flame. It also appears that gas ranging from about 15.5 candles to 19 candles can be used for the same slit, without giving rise to any very serious error in the result; with ordinary coal gas, ranging in quality from 16 to 18 candles, the light given by Mr. Methven's arrangement may be taken as constant.

Section 4 of the report contains the important observation that "compared with the sperm candle, Mr. Harcourt's air-gas flame is exact and trustworthy as a standard of light." It is stated that the combustible gas is a definite mixture so easily prepared that two samples made, from the same formula, in different apparatus cannot be distinguished by a skilled operator; and that "the extreme difference obtained by two observers in 19 determinations, by Mr. Harcourt's method of specially stored gas, was 0.3 candle, or 1.8 per cent.

The preparation and method of using the air gas is best described in Mr. Harcourt's paper read before the British Association in August, 1877. The combustible is rectified petroleum spirit, which distils at a temperature of not exceeding 50°C., and is mixed with 576 volumes of air to 1 volume of the liquid at 60° Fahr. Practically, 3 cubic inches of the spirit are mixed with one cubic foot of the air in a 7 cubic feet holder, similar to that used by the Metropolitan Gas Referees. The gas produced is burned at the rate of half a cubic foot per hour from a ½-inch orifice to produce a 2½-in. flame. Mr. Harcourt proposes to call the liquid "standard petroleum," and the combustible mixture "standard air gas," in substitution for pentane and pentane gas respectively.

Section 5 of the report is very important, as it contains the final expression of opinion on the part of the Committee, respecting the matters referred to them. In the first place the Committee record the results of their comparison of the variable candle standard with the air-gas flame, and state their convictions respecting the practical identity of value of the average sperm candle with Mr. Harcourt's standard. The Committee then recommend that in official documents the quantity of light furnished by coal gas should continue to be expressed in standard candles. In the actual photometrical measurement of gas, however, the use of the sperm candle should, in the opinion of the Committee, be discontinued, and Mr. Harcourt's air-gas flame used instead. In the event, however, of some modification of Messrs. Keates and Sugg's lamp, or Mr. Methven's screen, being resorted to, "on account of its practical convenience," this other mode of measurement should be checked, and referred to the air-gas flame as the sole official standard.

The result of the reference, therefore, is to cast the time-honored sperm candle into hopeless discredit; and that this is deserved is amply proved by a very superficial examination of the tests devoted to the candle, recorded in the appendix. The Committee have been very tender in their treatment of the two standards to which they accord a qualified approval. They refrain from altogether shutting the door to either of these systems, while pointing out their reasons for withholding full approval in each case. The recorded failure on the part of Mr. Methven to so arrange his screen standard as to give accurate readings through a range of 4 candles above and below the normal 16-candle standpoint, is certainly disappointing. Still, as, for example, the common gas supplied to the Metropolis by the three Companies whose operations are watched by the Referees, never varies throughout the year by such an amount as would prejudice the rectitude of the Methven standard, it is evident that much saving of labor on the part of testing officials would result from the use by them of this exceedingly simple system. Following out the recommendations of the Committee, expressed and implied, practical accuracy far exceeding the present observations would be attained by the regular use of Methven's standard, checked occasionally by

reference to the air-gas flame. The use of the latter might also be insisted upon whenever the coal gas under examination should betray unusual aberrations. It would at least be interesting to see the result of a prolonged trial of such revised methods of testing in the ordinary working of the Metropolitan Gas Examiners.

With respect to the possible adoption of the sperm oil lamp of Messrs. Keates and Sugg, it is difficult to speak very hopefully. When in perfect order and well used, it is by far the most suitable unit, regarded philosophically; since it is nominally of equal value to the usual quality of common coal gas. By its use we have an approximation to the even balance, as employed for weighing ponderable bodies; whereas the other standards referred to are more comparable to steelyards of unequal arms. It is unnecessary to say which is the more correct class of machine. As against this theoretical advantage, however, it is to be remembered that the use of the lamp makes no small demands on the time and care of the operator; and that, after all possible skill has been exerted to arrive at perfection, there is the possibility of disturbing causes arising in connection with the wick and other parts of the system. On the whole, without questioning the possibility of other standards being constituted and perfected at some future time, we must allow that, in the facts before them, the Committee have full justification for their recommendations.

We also consider that much practical wisdom was displayed in the retention by the Committee of the term "candle power," as representing the luminous value of gas. It is doubtless unscientific, and savoring of a bygone time, to express degrees of artificial light in terms of a small and almost obsolete article, such as a candle. Eventually, perhaps, we shall commonly speak of degrees of light as we do of degrees of heat. At present, however, the more homely unit is both legally and colloquially referred to; and the idea of the Committee in regard to this part of the question is merely to define the value of the unit and protect it from accidental alteration. It may, of course, be urged that it will be illogical to speak of gas as being of so many candle power, when the measurement is based on a flame of petroleum spirit mixed with air. But in this case the raising of a nominal unit from direct association with the object from which its title is drawn, will be quite in accordance with the usual order of things. A foot-measure is still spoken of by its immemorial name, although it is now the third part of the standard yard, instead of being built up from the unit of "three dry barleycorns taken from the center of the ear." Hence the Committee have both reason and precedent in their favor in that, having found cause for discarding an actual unit of light because of its incurable vacillations, they retain the old name for convenience sake, and suggest a means whereby it may always be made of a definite value.

It now remains to be seen what action will be taken by the Board of Trade on this most important and valuable report; for, of course, the material standard candle must remain the only legal unit for measuring the illuminating power of gas sold in this Kingdom, until an alteration is made by Parliament.

Electric Light Accident.

A serious accident, showing the dangers to be apprehended from electric lights, happened last week at the store of Allman and Co., hatters, No. 256 West Fifth street, Cincinnati. Mr. Elliott, a clerk in the store, entered the show window for the purpose of turning on the electric current, using a brass staff or rod. Before touching the cut-off, the rod happened to touch the metal support of the light, and Mr. Elliott received a shock that threw him out with great force against the window pane, breaking it into a thousand pieces, cutting him severely about the face and head. The force of the shock was so great as to almost render Mr. Elliott insensible, and but for the interposition of goods in the window would have thrown him into the street.

Mr. Allman professes to be a friend of the new illuminator, but thinks that proper instructions should be given to prevent such accidents, now that users of the current are new to its eccentricities and power.

Three weeks ago one of the electric light wires of the same establishment leading across the roof, had its insulating material worn through, and, contact being had with the tin roofing, a small fire resulted.—*Exchange.*

New Heating Apparatus.

The great calorific capacity of water has hitherto rendered it the most usual reservoir of utilized heat. There are, however, some fusible bodies which allow the storing of a much greater quantity of heat in the same volume without increasing the temperature of the vessels which contain them. Acetate of soda, for example, when melted, contains about four times as much available heat as water.

M. A. Ancelin has accordingly experimented with it in suitable boxes for warming cars and carriages. His experiments upon the French railways have been so satisfactory that his system seems likely to be adopted by many of the railways in Portugal, Italy, Spain and England.—*Comptes Rendus.*

Coal Production of Great Britain.

The returns recorded by the Keeper of Mining Records furnished since the year 1854 are purely voluntary, obtained from the coal owners of the United Kingdom. These returns have hitherto been found useful, and are here continued since 1864, according to H.M. Inspectors of Mines and the Mining Record Office. They are as follows:

Year.	H.M. Inspectors Returns. Tons.	Mining Record Office Returns. Tons.
1864	95,122,919	92,787,873
1865	98,911,169	98,150,587
1866	100,728,881	101,630,544
1867	105,077,743	104,500,480
1868	104,566,959	103,141,157
1869	108,003,485	107,427,557
1870	112,875,725	110,431,192
1871	117,439,251	117,352,028
1872	123,393,853	123,497,316
1873	128,680,131	127,016,747
1874	126,590,018	125,043,257
1875	133,306,485	131,867,105
1876	134,125,166	133,344,766
1877	132,179,968	134,610,763
1878	132,612,063	132,607,866
1879	133,720,393	134,008,228
1880	146,969,409	146,818,622

—London *Mining Journal.*

Purification of Carbon Disulphide.

E. Allary, in *Chemical News*, proposes to cover the sulphide with a layer of water, to which a solution of permanganate is added frequently in small quantities. Each addition is followed by stirring and is repeated till the supernatant liquid retains its purple color.

The permanganate is then removed by washing and decantation, and freed from water by means of a tap-funnel, and filtered through a dry double filter of Prat-Dumas paper. The purified sulphide must not be exposed to light.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

The Pottsville Explosion.

PHILADELPHIA, PA., November 11, 1881.

Mr. Editor: An article in your issue of November 2d, entitled "Gas Explosion in Pottsville, Pa.," gives a very erroneous account of the affair; and it is but right that, as such, it should be corrected through the columns of your paper—so we trust that you will give this space.

The "machine" in question was a set of Lowe water gas apparatus. By some carelessness the seal in the washer (in coal gas works called hydraulic main) was broken, which allowed the gas to flow back, and, becoming mixed with air from the superheater (open retort in coal works), soon formed an explosive mixture which, taking fire, exploded the washer. This was at 8:30 A.M.

A duplicate set of apparatus in same building, and which was standing *cold* at the time, was fired up, and in less than seven hours 40,000 feet of gas had been made, and stored in the holder, ready for the night's consumption; so that there was no resort to "tallow dips," as your correspondent stated.

Very respectfully, yours,

A. O. GRANGER & Co.

Corrections by Mr. Humphreys.

BERGEN POINT, N. J., Nov. 11, 1881.

Mr. Editor: Will you kindly allow me space to note a couple of errors that occur in my paper, as printed in your last issue?

The first is on page 198, second column, 19th line from bottom; after "of," at end of line, insert "travel of," so as to read "attached at the two extreme points of travel of the machine."

The second one is in the table, page 200. Price for coke-men for first quarter should be $1.50, not $1.75.

Respectfully,

C. J. RUSSEL HUMPHREYS.

THE AMERICAN
GAS LIGHT JOURNAL

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WEDNESDAY, NOVEMBER 16, 1881.

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.
(with W B Scott & Co.,)
34 PINE STREET, NEW YORK CITY.

NOVEMBER 16, 1881.

☞ All communications will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

Gas Co.'s of N. Y. City.

	Capital.	Par.	Bid.	Asked
Central	$466,000	50	60	65
Harlem	1,800,000	50	90	95
" Bonds	170,000			103
Manhattan	4,000,000	50	210	215
Metropolitan	2,500,000	100	152	155
" Bonds	658,000	..	107	110
Mutual	5,000,000	100	72	75
" Bonds, go'd.	900,000	1000	100	104
Municipal	1,500,000	100	175	178
" Bonds	750,000		106	110
New York	4,000,000	100	103	105x
Northern	270 000	50	—	100

Gas Co's of Brooklyn.

Brooklyn	2.000,000	25	128	132
Citizens	1,200,000	20	50	53
" S. F. Bonds.	320,000	1000	100	105
Fulton Municipal	1,500,000	100	68	72
Peoples	1,000,000	10	35	40
" Bonds	290,000		101	104
" "	250,000	...	70	75
Metropolitan	1,000,000	100	65	70
Nassau	1,000,000	25	65	70
" Ctfs.	700,000	1000	95	100
Williamsburgh	1,000,000	50	65	70
" Bonds	1,000,000		98	102
Richmond Co., S. I.	300,000	50	70	75
" Bonds	40,000	—	—	—

Out of Town Gas Companies.

Buffalo Mutual, N. Y	750,000	100	72	76
" Bonds	200,000	1000	95	100
Citizens, Newark	918,000	50	85	90
" " Bds.	124,000	—	105	10
Chicago Gas Co., Ills			125	—
Cincinnati G. & C. Co.			178	180
Consolidated, Balt.			43	44
Bonds			107	—
East Boston, Mass		25	114	120
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	140	144
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150.000	40	117½	
Jersey City	750,000	20	155	160
Jacksonville, Ill	120,000	50	100	...
Lewistown Maine	400,000	100	—	100
Laclede St Louis Mo	1,200,000	50	108	110
Montreal, Canada	2,000,000	100	153	154
New Haven, Conn		25	132	—
Oakland, Cal			32	33
Peoples, Jersey City		...	95	100
" " Bds.				5
Pittsfield, Mass			120	130
Rochester, N. Y		50	70	80
" Citizens		100	30	35
Wilmington, Del		50	174	...
Yonkers		50	30	32
St. Louis Missouri	600,000	50	250	254
San Francisco Gas-Co., S. Fr'isco Cal.			68	69
Toledo, Ohio			95	97
Troy, Citizens	600,000	100	—	—
Washington, D. C	1,500,000	20	185	200
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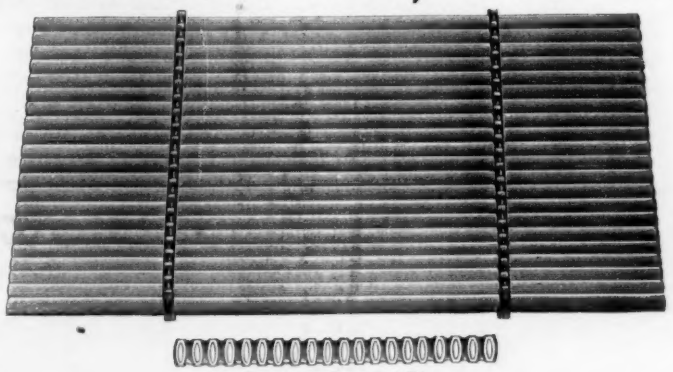

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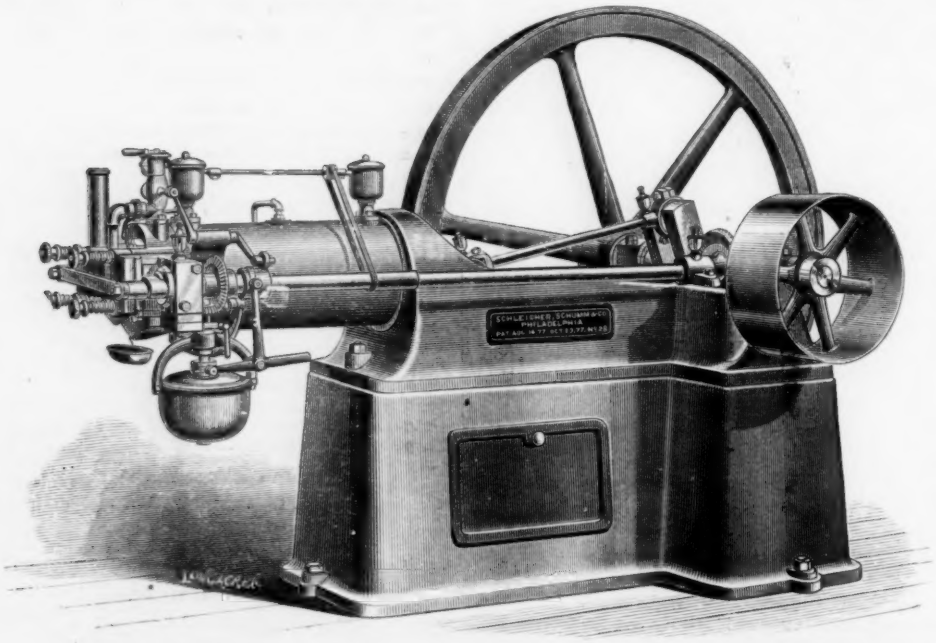

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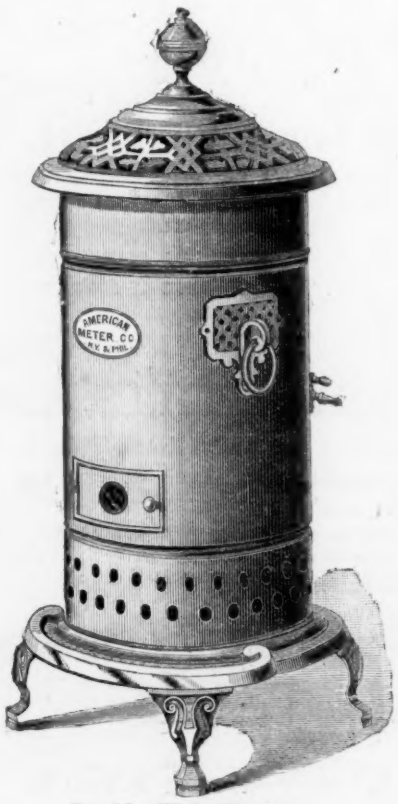

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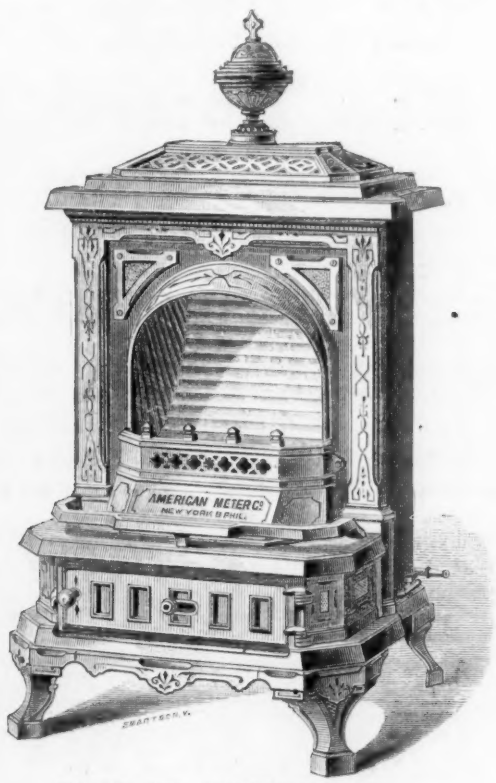

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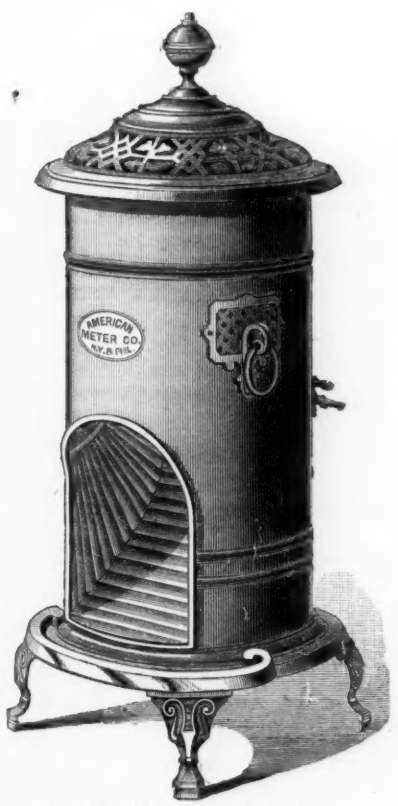

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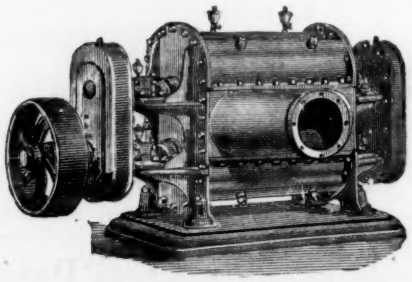

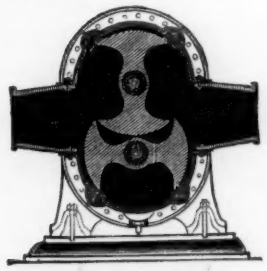

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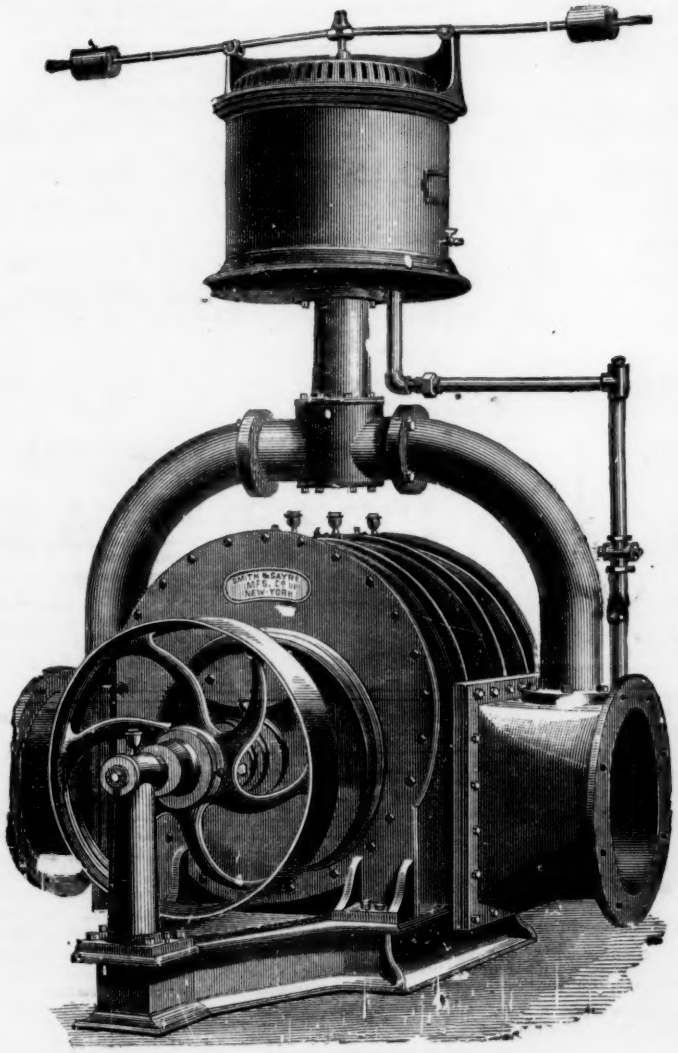

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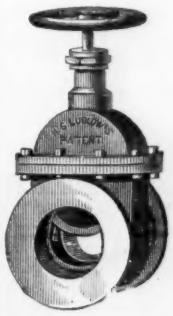

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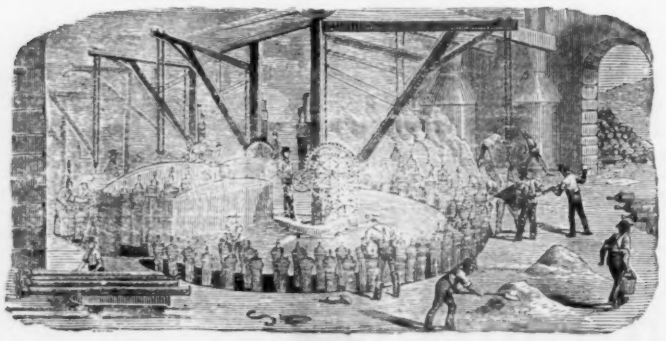

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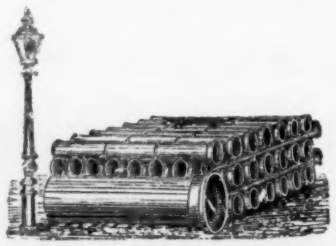

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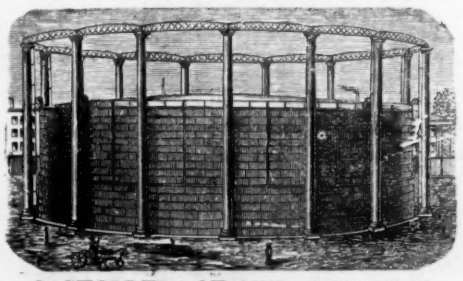

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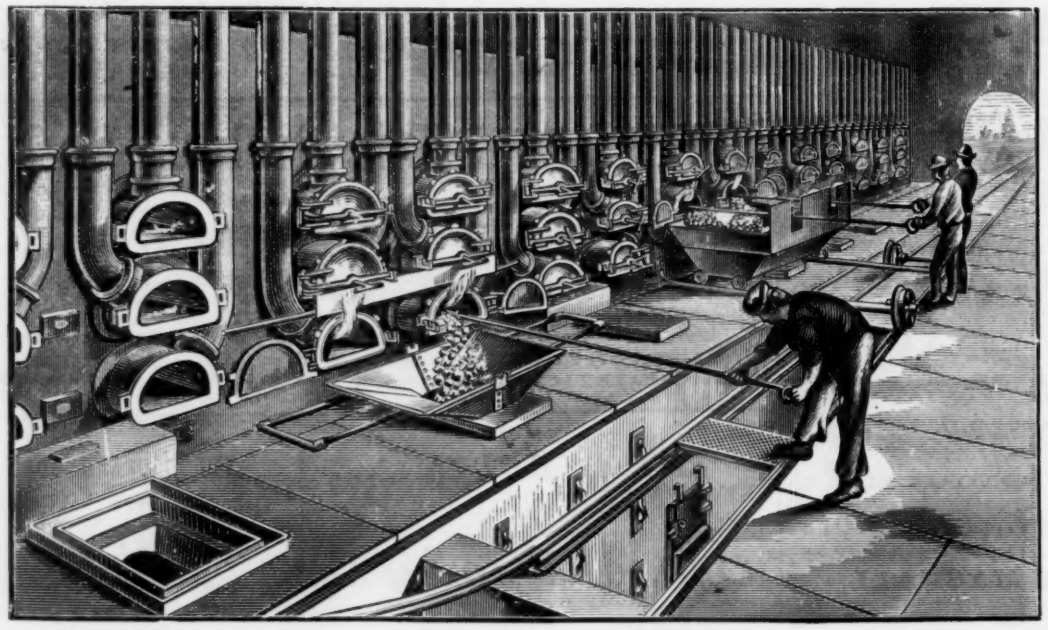

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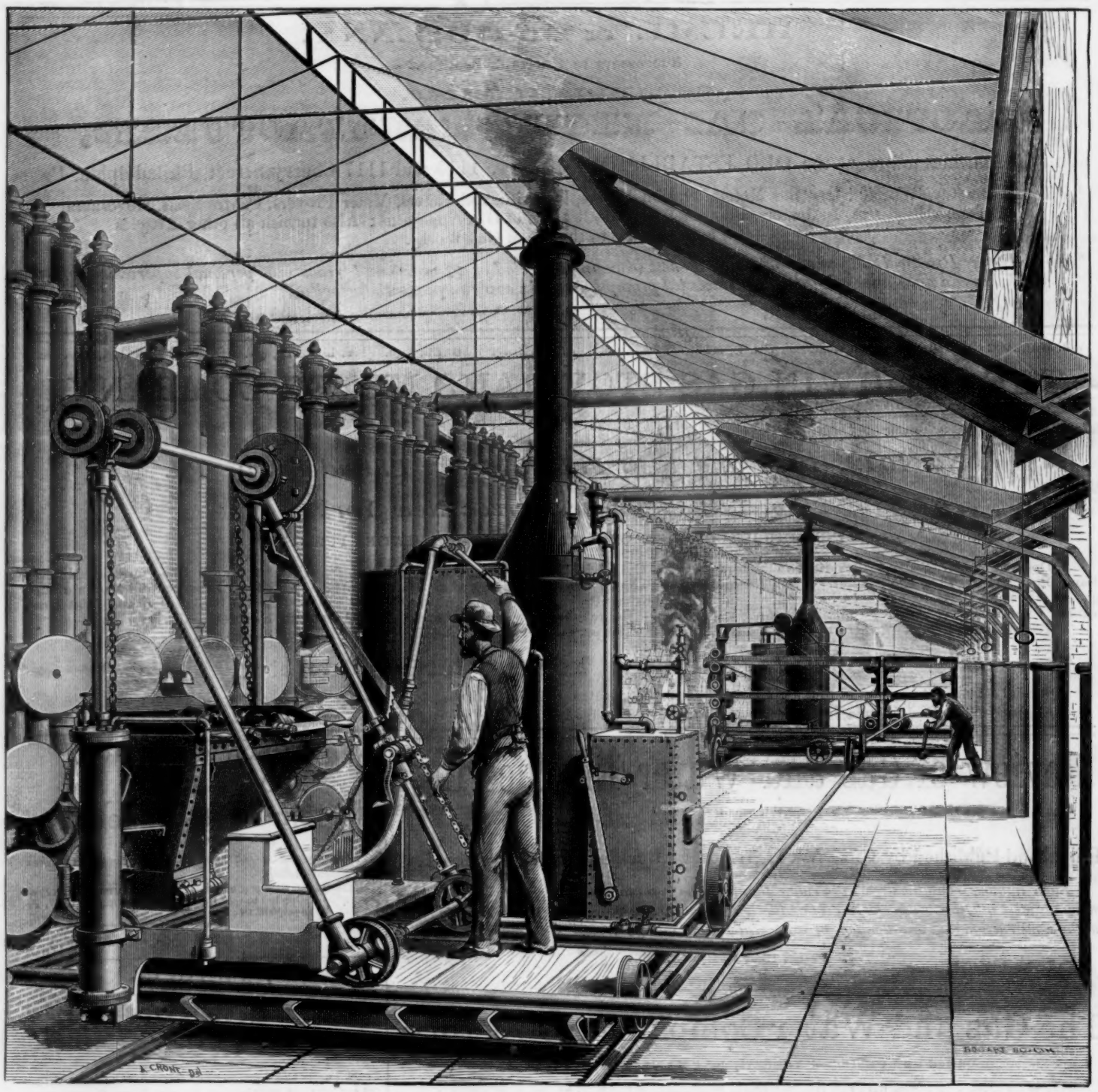

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